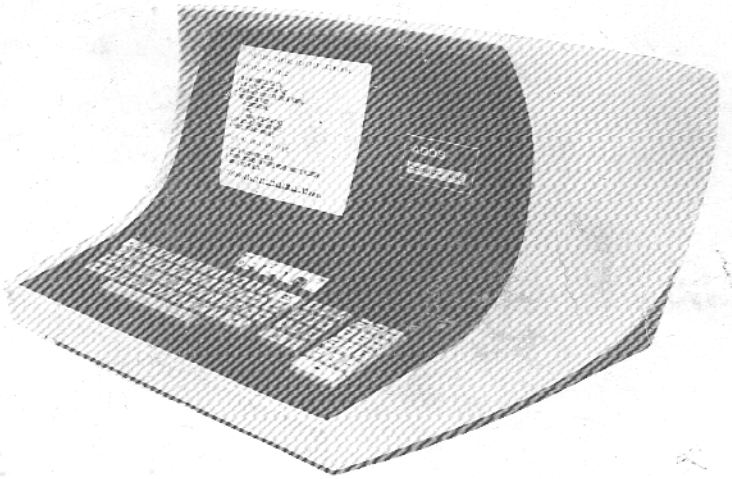
How to use the CONSUL and MRD-700



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HOW TO USE THE CONSUL AND MRD-700

A Terminal Operator's Guide

and

Interface Manual

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80-3010-D

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1. INTRODUCTION

General Description

The Consul is a self contained desktop CRT terminal designed for man-machine interaction in a wide variety of computer-based systems. Although it may be used as a direct replacement for a Teletype*, the Consul provides the advantage of greater transmission speeds, local editing, reduced system overhead, elimination of operator fatigue and the reliability of solid state integrated circuits. The Consul is also available configured for direct parallel interface to a user's hardware.

The MRD-700 is a rack-mountable terminal with the full functional capability of the CONSUL series. It consists of the CONSUL electronics packaged in a chassis which mounts in standard 19" RETMA racks. Total vertical panel height is 5¼ inches. A separate keyboard and TV monitor are connected to the MRD-700 to form a complete terminal system.

Models

Two standard models of the CONSUL and the MRD-700 are available; they are differentiated by memory capacity:

Model	CONSUL 840/MRD-740	CONSUL 880/MRD-780
Characters/Line	64	80
Lines/Display	16	24

Three operating modes can be selected by the operator: Conversational, Page or Message mode.

Conversational Mode

In this mode the terminal operates exactly like a teletypewriter. Each time the operator depresses a key on the keyboard a character is transmitted. If the character is displayable (and if the terminal is in Half-Duplex mode) it will simultaneously appear on the screen as it is transmitted. If the terminal is in Full-Duplex mode the character will be transmitted without appearing on the screen. The set of displayable and non-displayable characters generated by the keyboard is identical to the "printing" and "non-printing" characters which can be generated by the Teletype* Model 33 or Model 35 keyboard. When the display screen is filled a scroll feature rolls data upward one line at

*Registered trademark of the Teletype Corp.

a time simulating the line-feed action of a page teletypewriter.

The Edit sub-mode allows an operator to edit data in the Conversational mode without retyping entire lines. When the operator moves the cursor to correct an error, the terminal automatically switches into the Edit sub-mode wherein "live" transmission from the keyboard is suspended. Once editing is completed, the entire corrected line is retransmitted and the terminal automatically switches back to the normal Conversational mode. As a visual aid, the normal black character and white background display is inverted in the line being edited and white characters are displayed on a black background within that line until it is retransmitted by the operator.

Page Mode

This operating mode permits the operator to locally display and edit an entire page of data before transmitting any information to the computer. When in Page mode, activation of the TRANSMIT key causes the entire page to be transmitted. The operator can use five cursor controls (Forward, Back, Up, Down and Home), Horizontal Tab, and Screen Erase to edit the displayed data. The Insert/Delete feature enables the operator to insert or delete a character at any position in the display.

In Page mode a "look ahead" feature scans ahead during transmission of each line and if the remainder of the current line is blank* the line is immediately terminated by sending appropriate codes (carriage return and line feed) and the cursor advances to transmit the next line. In this manner transmission time is conserved and unnecessary trailing blanks on each line are not transmitted.

Message Mode

This mode permits the operator to locally display and edit data before transmitting to the computer. However, unlike the Page mode, activation of the TRANSMIT key causes only the line in which the cursor is presently located to be transmitted to the computer. In this way, the operator (or the computer) can cause the selective transmission of a line-at-a-time.

*In this manual the words "blank" and "space" are used in the same context. A "blank" on the screen represents an ASCII code for space stored in Memory (SP = 0100000). For example, Screen Erase means "to store space codes throughout memory." The screen will appear blank after a Screen Erase.

As in the Page mode, a "look ahead" feature suppresses trailing blanks and causes the line terminator (Carriage Return) to be sent immediately, when the remainder of the line is blank.

Time-sharing systems unable to accept a full page of data in a single block can utilize the Message mode to accept a block of data as a sequence of line messages

Formatting

A Formatting feature which can be used in either the Page or Message mode permits simultaneous display of both fixed and variable data. This feature not only makes data entry easier and faster, but also helps assure complete entry of all required data.

When the Formatting feature is on, the operator may request a particular form from the computer or may load the form from a tape cassette. Then the operator fills in the blank spaces on the form with variable data. When the TRANSMIT key is depressed the terminal transmits only variable data, skipping over the fixed data fields which comprise the form. As a visual aid, fixed data (the form) appears on the screen at half-intensity and variable data appears at full-intensity. In this type of operation the tab control allows the operator to skip directly from one variable field to the next variable field when filling out the form. During transmission of a form the look-ahead feature suppresses unnecessary trailing blanks and advances the cursor to begin transmitting the next line, when the remainder of the current line is blank.

Communication Interfaces

An EIA serial interface conforming to EIA RS-232-C specifications is standard. This interface operates in full or half-duplex at switch selectable speeds of 110, 300, 1200, 1800 and 2400 baud. Other baud rates are available on special order. A serial terminal can also be provided with an optional current loop interface identical to the 20 milliampere interface available on a teletypewriter.

A parallel interface is optionally available for direct connection to a computer. The parallel interface operates on a "request-acknowledge" basis and permits data transfer rates of up to 1500 characters per second.

Optional Built-In Modem (Consul Series Only)

The CONSUL may also be ordered with a built-in low speed modem compatible with Model 103 datasets. If this option is ordered the user can couple acoustically to a telephone line at a selectable speed of 110 or 300 baud, in addition to having available the five-speed EIA interface mentioned in the preceding paragraph.

Optional Graphics (Model 880 and 780)

An optional graphics capability is available on the CONSUL 880 and MRD-780. This option provides a matrix of 11,520 elements that can be used to generate business-level graphics such as bar charts and trend curves. Alphanumeric as well as graphic characters can be simultaneously displayed using this graphics technique.

Optional Printer/Cassette Interface

The ADDS Cassette Tape Recorder/Reproducer (Model 804) and Thermal Printers (Model 805 and 815) can be connected to the optional printer/cassette interface. These peripherals may be used on-line for recording (or printing) all data transmitted and received by the terminal. Printers operate at a maximum on-line speed of 300 baud while the Model 804 tape unit operates at speeds of up to 2400 baud.

The peripherals can also operate off-line for locally recording or printing a full screen of data. During local operation nothing is transmitted via the communications interface even though a connection may be established between the terminal and a remote computer. This LOCAL PRINT feature enables one to take a local "snapshot" of the display on hard copy and/or magnetic tape.

The printer/cassette interface can also be used to drive a teletypewriter (on-line or locally) at a maximum speed of 110 baud. The teletypewriter can be equipped with either an EIA or current loop interface.

2. INITIAL CHECKOUT AND FUNCTIONAL TEST

2.1 Consul Series Initial Checkout

Upon removal of the CONSUL from its shipping container note the power cord, mating connectors and manuals placed in the plastic bag accompanying the unit. Carefully cut the plastic straps and remove the plastic bag which protects the terminal for shipment. The front and rear of the CONSUL appears as shown in Figures 2.1 and 2.2.

Note that the cooling fan for the CONSUL is located beneath the terminal and pulls cool air from the rear of the unit and exhausts warm air at the bottom. Do not operate the terminal with papers or other loose material underneath the base which could obstruct air exhaust.

Conduct a brief visual check for any physical damage to the unit as a result of mishandling during shipment. If the appearance of the unit is satisfactory, uncoil the line cord; connect the female plug to the connector at the rear of the terminal and the male plug to any standard 115V AC receptacle.

Units specifically ordered for foreign use can be connected to 230V/50 cycle power.

> Note: Do not connect terminals wired for 115 volts to 230 volt receptacles.

Depress the front-panel POWER switch (A) to the ON position. The red POWER indicator next to the switch should illuminate indicating that the terminal is properly connected to the power receptacle. If this indicator does not light, check the line cord. (If the cord is properly connected and you have ascertained that the wall receptacle contains power, the fuse on the rear panel should be checked. The fuse is type 3AG 1.5 ampere, SLO-BLO.) Place the CONSUL in Page mode by means of the MODE Select pushbuttons (B) and enter characters from the keyboard. Adjust the display to the appearance you desire by using the TV monitor controls located on the rear panel:

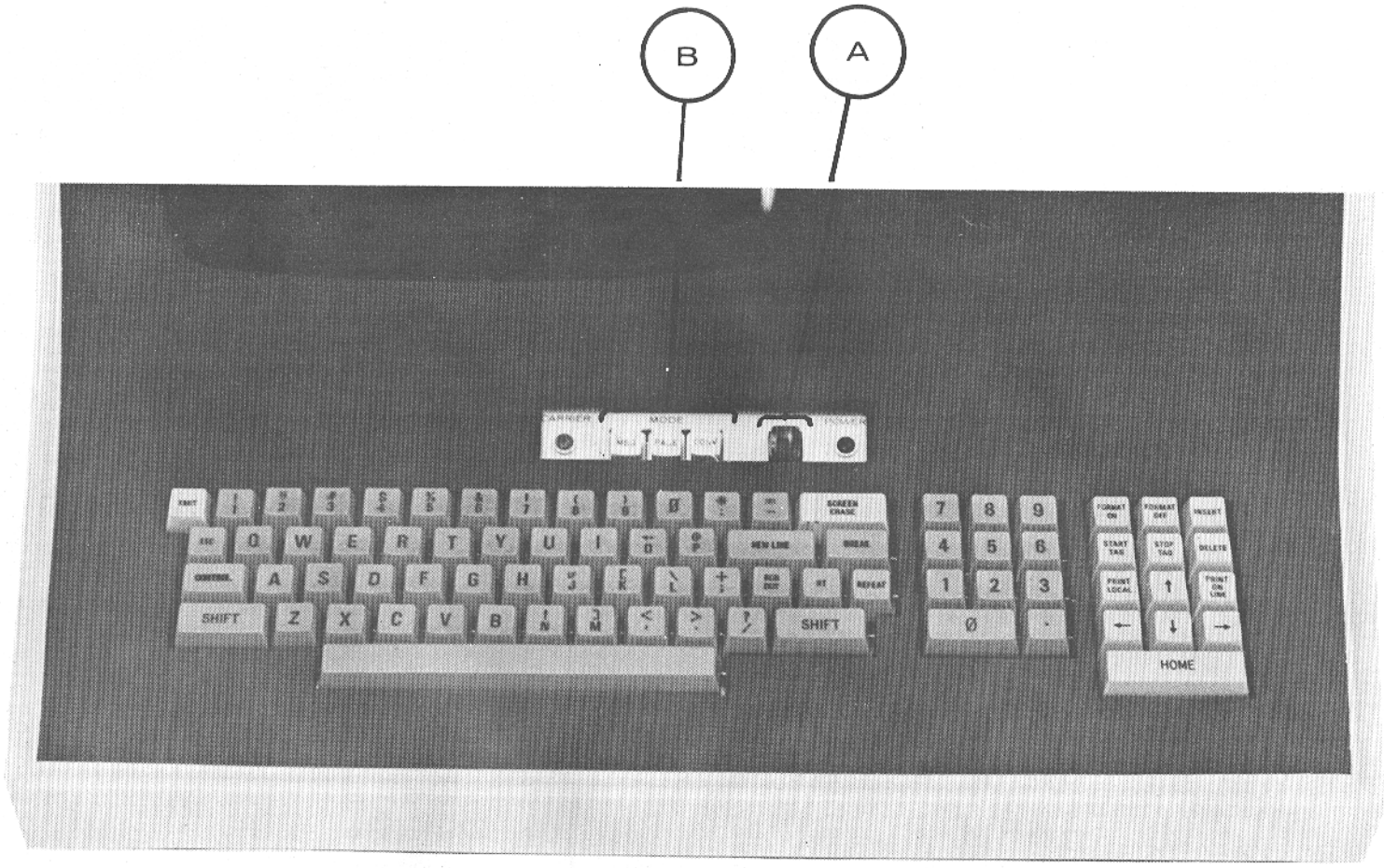
BRITE (Brightness)

CONT (Contrast)

For CONSULS ordered with the printer/cassette interface, the Printer and Cassette toggle switches on the rear panel should be placed in the OFF position during initial checkout.

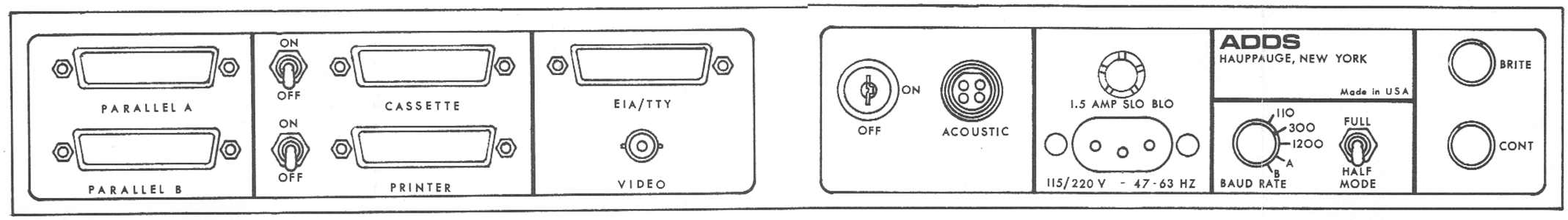
CONSUL FRONT PANEL CONTROLS

Fig. 2-1



CONSUL REAR PANEL

Fig. 2·2



2.2 MRD-700 Series Initial Checkout

Upon removal of the MRD-700 from its shipping container note the mating connectors and manual placed in the plastic bag accompanying the unit. The front and rear of the MRD-700 appear as shown in Figure 2.3.

Conduct a brief visual check for any physical damage due to mishandling in shipment. If rough handling is suspected open the front panel (by removing the two Phillips-head screws at the right front side and swinging the panel open on its hinge) and verify that all PC cards are properly seated.

Plug the power cord into a 115 volt AC receptacle.

Your MRD-700 can be factory-wired to operate on 230 volts.

> Note: Do not connect units wired for 115 volts to 230 volt receptacles.

Connect a TV monitor to the BNC VIDEO connector on the rear panel. The output of the MRD-700 is standard EIA (RS 170) Composite Video. The MRD-700 is shipped with a 6-foot video connecting cable (RG-59/U) which has a BNC connector at one end and a UHF connector at the other end, to match the type most commonly used in TV monitors. Turn the monitor power switch ON and adjust contrast and brightness until the raster lines are visible.

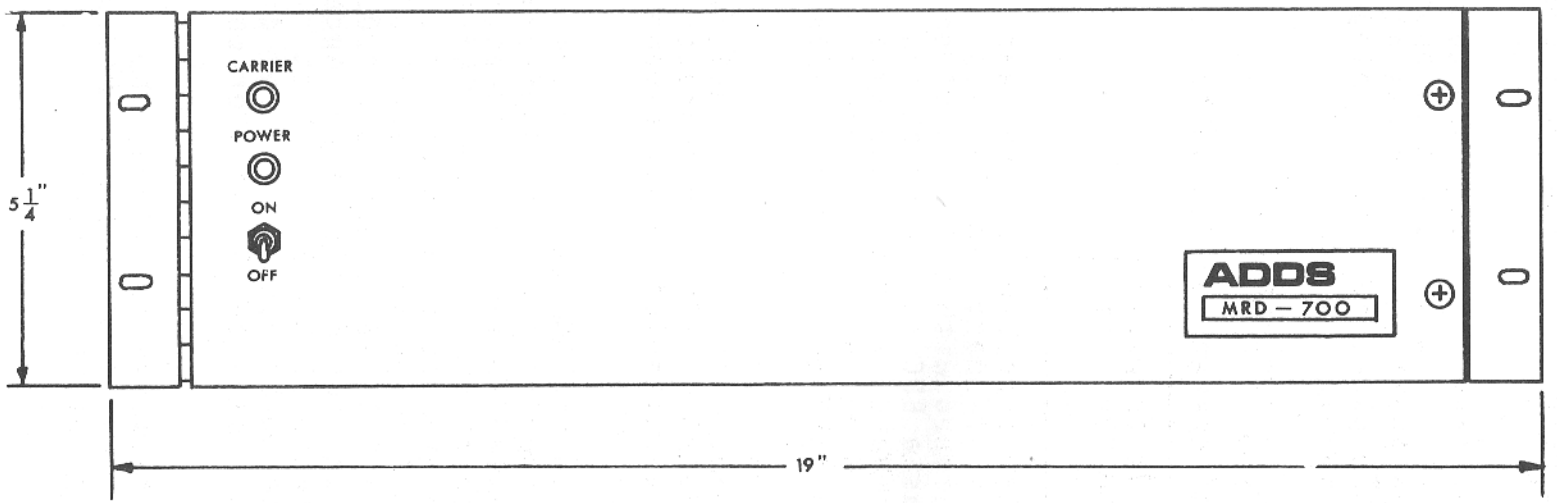
The MRD-700 keyboard should be plugged into the rear panel connectors labeled KEYBOARD A and KEYBOARD B. The two connectors which terminate the keyboard cable are labeled in corresponding fashion.

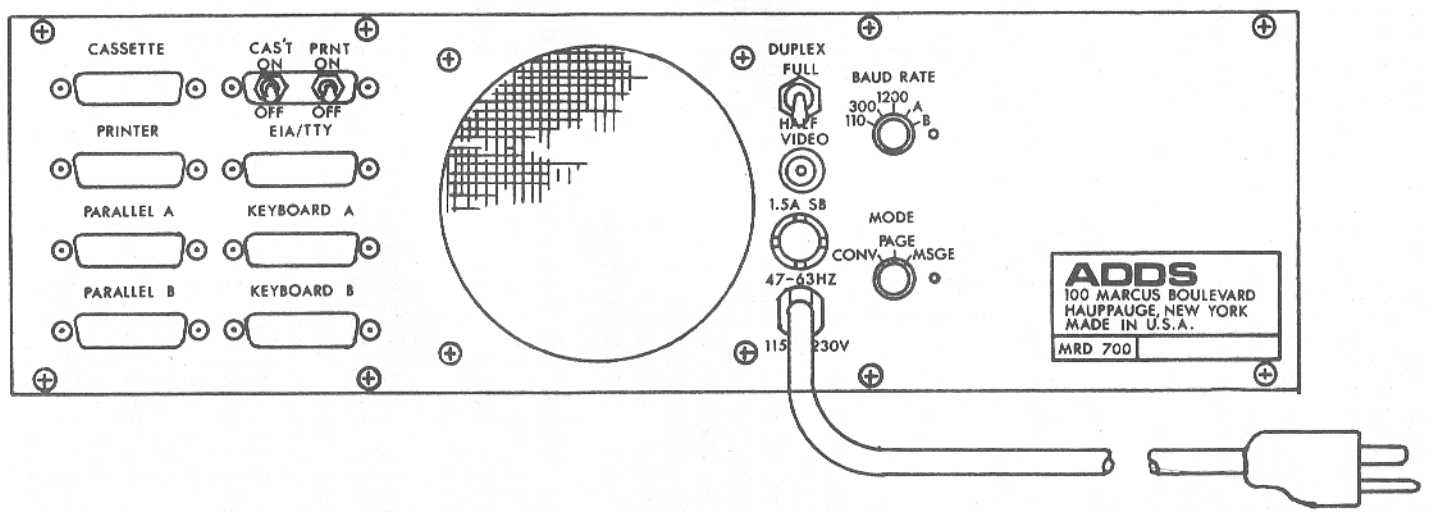
Place the front-panel POWER switch in the ON position. The POWER indicator next to the switch should illuminate indicating that the terminal is properly connected to the power receptacle. If this indicator does not light, check the line cord. (If the cord is properly connected and you have ascertained that the wall receptacle contains power, the fuse on the rear panel should be checked. The fuse is type 3AG 1.5 ampere, SLO-BLO.) At this time you can adjust the screen for desired appearance. Place the MRD-700 in Page mode by means of the MODE Select switch and enter characters from the keyboard. Adjust the display to the appearance you desire by using the TV monitor controls.

For units ordered with the printer/cassette interface, the Printer and Cassette toggle switches on the rear panel should be placed in the OFF position during initial checkout.

MRD 700 FRONT AND REAR PANELS

Fig. 2-3





2.3 Functional Test

Using the keyboard the following functions should now be checked (in PAGE mode):

(a) ERASE — Hold the CONTROL key down and depress SCREEN ERASE.

(b) Cursor keys — Depressing each of the five cursor keys (Up, Down, Forward, Back, Home) should result in the corresponding cursor motion. Note that Cursor "home" is the upper left corner of the screen in Page mode.

(c) Data Entry — Each time an alphanumeric key is depressed, the corresponding character should be entered on the screen and the cursor automatically advances one location.

(d) REPEAT key — Hold the REPEAT key down. If any alphanumeric key or cursor key is then held down, the corresponding data entry or cursor motion occurs continuously, at a rate of 15 times per second. When the REPEAT key is released, the repetitive function stops.

(e) INSERT/DELETE — Type a group of characters and back up the cursor so that it is within the group. When the DELETE key is depressed, the character above the cursor should be deleted and characters to the right of the cursor on the line of interest move left one position to close up the location where a character was deleted.

To check the Insert function, type a group of characters and back up the cursor so that it is within the group. Then press the INSERT key once. If new data is entered it will be inserted within the original set of characters. Each time a character is inserted the cursor moves to the right one position and data to the right of the cursor moves as well. Press the INSERT key once again to revert to a non-Insert mode of operation. Repeat the test described above, noting that new data is over-written rather than inserted.

(f) BLINK

Depress FORMAT OFF, START TAG and key in several alphanumeric characters. These characters should blink. Then depress STOP TAG and continue keying data. These characters should appear non-blinking.

(g) FORMAT

Erase the screen. Depress FORMAT ON, START TAG and key in several alphanumeric characters; then, depress STOP TAG and continue keying data. The tagged characters should be displayed at half-intensity (gray) and the non-tagged characters at full intensity. Erasing the screen, as in (a) above, should erase only the unprotected (full-intensity) characters. Now depress FORMAT OFF; this will cause the protected data to become unprotected. The visual effect is that data which was previously displayed at half-intensity now appears blinking. At this point erase the screen, noting that all data is erased and the cursor is automatically positioned to the upper left corner of the display page.

(h) XMIT (serial)

Enter characters on each line. Position the cursor to the center of the screen, and depress the XMIT key. The cursor should automatically go to the upper left corner of the screen and move through each screen position displaying either a character or intervening blank. After moving through all character positions the cursor should return to the upper left hand corner. Note that trailing blanks on each line are not transmitted. Transmission occurs at a speed determined by the setting of the BAUD RATE switch.

(i) XMIT (parallel)

If your terminal is equipped with a parallel **front** end, jumper "Character Ready" to "External Device Busy" on the Parallel Data connectors before testing XMIT, as described in Section 4.3.2. When the XMIT key is depressed the cursor should move very rapidly through all character positions on the screen and return to the home (upper left) position. Since trailing blanks on each line are suppressed during transmission, enter characters near the right end of each line before testing a parallel XMIT operation; this permits the rapid cursor motion to be visible.

(j) CONV mode

Select the Conversational (CONV) mode, and set the terminal in HALF-DUPLEX. [If your terminal has a parallel front end, jumper "Characters Ready" to "External Device Busy", as described in Section 4.3.2]. Now do a Screen Erase function (CONTROL key plus SCREEN ERASE key) and observe that the screen is erased, with the cursor going to the upper left corner. Press the Cursor HOME and note that the cursor goes to the lower left corner, which is the "home" position for Conversational mode. Enter a string of characters in the bottom line and press the NEW LINE key. The data should scroll upwards one line. Continue the process of entering data and scrolling it upwards until all lines have been filled. None of the data which was entered and then moved upwards should have been changed during the scrolling process. Press Cursor Forward and observe that the line in which the cursor is located has a color reversal (white characters on a black background, instead of the normal black-on-white display.) This indicates that the Edit sub-mode has been enabled. Enter data and then press the XMIT key and observe that:

1) the line with color reversal changes back to normal color

2) the cursor automatically advances through each character on the line that was in reverse color

3) the cursor stops at the beginning of the next line.

You have verified operation of the Edit sub-mode.

(k) Graphics

If your terminal is equipped with the Graphics option, enter a mixture of blinking and non-blinking characters by means of the alphanumeric keys and the START TAG and STOP TAG keys. Press CONTROL-Y and note that the blinking characters change to graphics characters. When FORMAT OFF is depressed the graphics characters change back to blinking alphanumerics.

If all of the above are operative, you are ready to connect the peripherals and start on-line operation. If any of the above functions are inoperative, please contact your nearest ADDS service location.

3. OPERATING INSTRUCTIONS

3.1 Mode Selection

One of three operating modes can be selected:

Conversational Mode
Page Mode
Message Mode

Three pushbutton switches for mode selection are located on the front of the CONSUL series of terminals. Mode selection for the MRD-700 series is accomplished by means of a rotary selector switch on the rear panel.

In addition, a two-position switch on the rear panel is used to select either of two possible communication modes; Full or Half-Duplex. This switch affects the operation of the terminal when it is in Conversational mode but has no effect when in Page or Message mode.

The rationale for this is as follows:

- Character-oriented communications can occur in either Full or Half-Duplex.

- Message-oriented communication (the Page and Message modes) are intrinsically Half-Duplex.

We shall discuss each mode in detail in following sections but wish to summarize the major differences at this point. The most basic difference between modes is the method of transmitting data from the terminal.

- In Conversational mode: When a key is depressed, the corresponding character is transmitted. This is directly analogous to the operation of a teletypewriter.

  Whether or not the character transmitted from the terminal goes to the display memory as well depends on whether the terminal is in the Full or Half-Duplex communication mode.

- In Page and Message modes: When a key is depressed, the corresponding character is entered into the terminal's memory and appears on the screen, but no data is transmitted out from terminal; i.e., the keyboard is used only for local entry of data into memory.

  In Page mode, the entire contents of the memory (the display "page" are transmitted as one block of characters when a TRANSMIT operation is initiated.

In Message mode, the characters corresponding to one line of characters within the display page are transmitted as a block of characters when a TRANSMIT operation is initiated.

3.2 Summary of Keyboard Functions

In this section are summarized all functions which can be performed from the keyboard. Two classes of keys are available to the terminal operator:

(a) Unencoded (Function) Keys

These keys do not generate codes but are used for only local editing of the display page or local control of the state of the terminal.

(b) Encoded Keys

The encoded keys generate all ASCII codes which can be generated from the keyboard of a Model 33 (or Model 35) teletypewriter. The ASCII codes generally cause characters to be displayed on the screen or affect the state of the terminal. The effect of the ASCII codes on the display itself is independent of the source of the codes; that is, a given ASCII code causes the same effect on the display whether it comes from the operator's keyboard or it is received by the terminal from a computer.

[In the functional descriptions which follow in this section, the effects for protected data - the "FORMAT" feature, are shown within square brackets. The use of protected data and Format control is discussed in detail in Section 3.4 of this manual.]

3.2.1 Unencoded (Local) Functions

3.2.1.1 Cursor Controls

The cursor is a 6-dot underline which indicates the location where the next entered character will appear (or the location from which a character will be read, for a transmit operation). The operator can move the cursor to any position on the screen without changing any of the displayed data. Five local cursor control keys are available on the keyboard:

(a) Cursor Home

The cursor goes to the beginning of the bottom line when the terminal is in Conversational mode; when in Page or Message mode the cursor goes to the beginning of the top line. [When the FORMAT ON state is enabled, the cursor goes to the first unprotected character position in the page.]

(b) Cursor Forward

The cursor moves forward one character position. If it is at the end of a line, the cursor moves to the beginning of the next line. If the terminal is in Conversational mode and the cursor is at the end of the bottom line, it moves to the beginning of a new blank bottom line which scrolls into view. If the terminal is in Page or Message mode the cursor advances from the end of the bottom line to the beginning of the top line. [When FORMAT ON state is enabled and the cursor is in the last position of an unprotected field it will skip protected data and go to the next unprotected character position.]

(c) Cursor Back

The cursor moves back one space. However, if it is at the beginning of a line it will not move in response to Cursor Back. [When FORMAT ON state is enabled the cursor will move back one space for each Cursor Back command, until it reaches either the beginning of the line or a protected field boundary. At that point it will not move further when Cursor Back is depressed.]

(d) Cursor Down

The cursor moves to the same relative position in the next line down. If it is in the bottom line, the cursor moves to the same relative position in the top line. [If the FORMAT ON state has been enabled, and the relative position in the next lower line is protected, the cursor skips forward in memory from that point and stops at the next unprotected location in the lower line.]

(e) Cursor Up

The cursor moves the same relative position in the next line up. If it is in the top line, the cursor moves to the same relative position in the bottom line. [When FORMAT ON state has been enabled and the relative position in the next higher line is protected, the cursor skips forward in memory and stops at the next unprotected location in the upper line.]

3.2.1.2 The TRANSMIT Key

Causes the transmission of a full page of data when in Page mode and one line of data when either in Message mode or the Conversational mode.

3.2.1.3 The DELETE Key

The cursor remains stationary, the character at the current cursor position is erased, and all characters in this line to the right of the cursor are moved left one position (a blank filling the rightmost character position in the line). Note that when the DELETE key is depressed, the Edit sub-mode is automatically enabled in Conversational mode. [If the FORMAT ON state has been enabled, the DELETE key performs similarly, but only operates on data within the unprotected field in which the cursor is currently located. The character at the current cursor position is deleted, the data from the cursor to the end of this unprotected field is left-justified one position, and a blank fills the rightmost position in the field.]

3.2.1.4 The REPEAT Key

If this key is held down and then any alphanumeric or cursor key is held down, the corresponding data entry or cursor motion occurs continously, at a rate of about 15 times per second. Do not use this key for "live" transmission from the terminal.

3.2.1.5 PRINT ON LINE Key

This is an alternate action key which permits peripheral devices to record or print the dialog between the terminal and a computer. (See Section 3.8 regarding connection of peripheral devices.

3.2.1.6 PRINT LOCAL Key

This momentary contact key causes the contents of the terminal memory to be locally recorded or printed. (See Section 3.8 regarding connection of peripheral devices.)

3.2.2 Encoded (ASCII) Functions

ASCII characters contain 7-bits; there are 128 such 7-bit codes which comprise the full ASCII character set. ADDS terminals utilize 76 of those codes to display data or perform various terminal functions. In Figure 3.1 is shown an ASCII code chart with those 76 codes. (Plus two more codes which are sometimes generated automatically by the ADDS terminal for block transmission; these two codes, ETX and GS, are not utilized for display or control when they are received by the terminal.)

ASCII CODES UTILIZED

Fig. 3-1

B7 →	Ø	Ø	Ø	Ø	1	1	1	1
B6 →	Ø	Ø	1	1	Ø	Ø	1	1
B5 →	Ø	1	Ø	1	Ø	1	Ø	1
B4 B3 B2 B1 COL / ROW	0	1	2	3	4	5	6	7
Ø Ø Ø Ø Ø								
Ø Ø Ø 1 1		DC1						
Ø Ø 1 Ø 2								
Ø Ø 1 1 3	*ETX							
Ø 1 Ø Ø 4								
Ø 1 Ø 1 5	ENQ							
Ø 1 1 Ø 6								
Ø 1 1 1 7								
1 Ø Ø Ø 8								
1 Ø Ø 1 9	HT	EM						
1 Ø 1 Ø 10								
1 Ø 1 1 11	VT	ESC						
1 1 Ø Ø 12	FF							
1 1 Ø 1 13	CR	*GS						
1 1 1 Ø 14	SO	RS						
1 1 1 1 15	SI	US						

*Note: ETX and GS not utilized on input

We shall summarize below the effects produced by these codes. Note that these effects are achieved when generated from either an external source such as a computer or from the keyboard (when the terminal is in a half-duplex mode of operation.)

3.2.2.1 Display of Alphanumeric Data

The 64 "upper case" alphanumeric characters form the displayable ASCII character set for ADDS terminals. These 64 characters, which are sometimes referred to as "Compressed ASCII," are in columns 2 through 5 of the ASCII code chart. Figure 3.1 shows the actual dot matrix which appears on the terminal T. V. screen when these characters are received by the display. After each displayable character is entered in the display, the cursor automatically advances to indicate the next character location on the display. Note that the ASCII Space code (binary 0100000) causes a "blank" character to appear on the screen. New characters entered into the display replace characters previously shown; i.e., new data overwrites old data.

3.2.2.2 New Line (Carriage Return) Function

Receipt of the Carriage Return (CR) code erases any characters previously shown between the current cursor location and the end of the current line and the cursor is automatically placed to the beginning of the next line.

From the keyboard the CR code is generated when the NEW LINE key is depressed. It can also be generated as Control-M.

3.2.2.3 Screen Erase Function

Receipt of the Form Feed code (FF) erases the contents of the screen, and the cursor is automatically placed to the upper left position on the screen.

From the keyboard the FF code is generated when the SCREEN ERASE key (interlocked with the CONTROL key) is depressed. It can also be generated as Control-L.

[When the FORMAT ON state is enabled, the FF code erases all unprotected data and the cursor is placed at the first unprotected character location in the display.]

3.2.2.4 The Start Tag and Stop Tag Functions

The ASCII code Shift Out (SO) alerts the terminal that subsequent displayable characters should be entered into memory with the "tag" bit for those characters equal to logical one. The ASCII code Shift In (SI) causes subsequent displayable characters to be entered into memory with the "tag" bit equal to logical zero.

Thus, the string of displayable characters received between the SO code and the SI code, such as in the sequence

SO, T, E, X, T, SI,

constitute a tagged field. Tagged fields are used as

- protected data fields, or
- blinking data, or
- graphical data

depending the state of the terminal.

The SO code can be generated from the keyboard by the START TAG key, or as Control-N. The SI code can be generated from the keyboard by the STOP TAG key or as Control-O.

3.2.2.5 The Format ON and Format OFF Functions

The ASCII code RS causes a FORMAT ON state of the terminal, wherein tagged data becomes access protected. Code US causes a FORMAT OFF state, wherein tagged data is unprotected and may be altered. See Section 3.4 of this manual for a detailed discussion of protected data and Format control.

Code RS is generated from the keyboard by the FORMAT ON key or as Control-Shift-N. The US code is generated when one depresses the FORMAT OFF key or as Control-Shift-O.

3.2.2.6 The Graphics ON Control Function

Code EM puts the terminal in the Graphics mode (if the Graphics option card has been installed in the unit). In this mode tagged data is displayed as graphical rectangular elements rather than as alphanumeric characters; see Section 3.5 for details.

EM is generated from the keyboard as Control-Y.

3.2.2.7 Horizontal Tab

The ASCII code HT normally causes the cursor to skip to the next "fixed tab stop." Each line has fixed tab stops at 8-character field boundaries (0, 8, 16, etc.) for the Model 840/740 and at 5-character field boundaries (0, 5, 10, 15, etc.) for the Model 880/780.

The HT is generated from the terminal keyboard from the HT key or as Control-I.

(With FORMAT ON enabled, Horizontal Tab does not move the cursor between the normal fixed tab stops. Rather, it moves the cursor to the first location of the next unprotected field.)

3.2.2.8 Line Addressing - Absolute

The cursor can be positioned to the beginning of any arbitrarily selected line by means of the two-character sequence (VT, X). The Vertical Tab code (VT) causes the next character (its lower order five bits) to be interpreted as a binary line number, and the cursor will be set to the beginning of that line. (Code VT can be generated as control-K.)

Note: The character following the VT code in the addressing sequence should not be a control code. This means, in effect, that bits 7 and 6 in the line address character should not both be equal to logical zero. Recommended practice is bit 7 = 1 and bit 6 = 0.

3.2.2.9 Cursor Horizontal Addressing - Relative Forward

When the two-character ASCII sequence (ESC, ENQ) is generated the next two characters are taken as a two-digit cursor address, with reference to the current cursor position.

> (Note that the ASCII code ENQ can be generated from the terminal's keyboard as Control-E, and ESC can be generated from the ESC key or as Control-Shift-K.)

The four-character cursor addressing sequence (ESC, ENQ, X, Y) is restricted to values of X and Y between 0 and 9. The first decimal digit in the count, X, is the most significant.

As an example, assume that the cursor is located in character position number 6 of a given line, and the sequence (ESC, ENQ, 2, 5) is generated. The cursor appears to jump immediately to character position 31 in the line.

If the address count takes the cursor past the end of a line it appears to finish the count and arrives at the appropriate position in the next line. Since the possible cursor address count is in the range 0-99 and the maximum line of a CONSUL terminal is 80 characters in length, the cursor can always be addressed to go "past" the end of the line in which it is currently located.

[With FORMAT ON enabled, one should not try forward cursor addressing that would carry the cursor over a protected field. A sequence of HT codes should be used to get the cursor to the chosen variable data field, and then forward cursor addressing can be used within that field.]

3.2.2.10 Initiation of Transmission

When the terminal is in Page or Message mode, receipt of a DC1 code will initiate a block transmission from the terminal.

DC1 is generated from the terminal keyboard as Control-Q.

Table 3.1 summarizes all encoded control functions.

Table 3.1

ASCII Control Codes

ASCII Code	Generation from Keyboard	Function
ESC	ESC key or Control-Shift-K	First character of horizontal Cursor addressing sequence
ENQ	Control-E	Second character of horizontal Cursor addressing sequence
HT	HT Key or Control-I	Horizontal Tab
VT	Control-K	First character of line addressing sequence
FF	Screen erase key, or Control-L	Screen Erase
CR	NEW LINE key, or Control-M	Carriage Return
SO	START TAG key, or Control-N	Start tagging data
SI	STOP TAG key, or Control-O	Stop tagging data
DC1	Control-Q	Start block transmission
EM	Control-Y	Graphics mode ON
RS	FORMAT ON key, or Control-Shift-N	FORMAT mode ON
US	FORMAT OFF key, or Control-Shift-O	FORMAT mode OFF

3.3 Operating Modes - Detailed Description

3.3.1 Conversational Mode

This mode enables the terminal to transmit and receive data on a character-by-character basis in a manner identical to that of a teletypewriter.

In Conversational mode a "scroll" type of presentation is employed. When the current line is the bottom line of the display and the cursor attempts to advance to a new line, all data lines are advanced upward with the top line lost and the bottom line cleared. The visual effect to the operator is an "upward scroll" with new data entered from the bottom and moving upward one line at a time. When in the Conversational mode, the terminal may be set to operate in Half or Full-Duplex. There is also a special Edit sub-mode available. These are discussed below.

3.3.1.1 Conversational; Half-Duplex

When any encoded key is depressed the corresponding character is transmitted and if the character is displayable, it is displayed on the screen simultaneously with transmission to the computer. The set of displayable and non-displayable characters which can be generated by means of the terminal keyboard is identical to the "printing" and "non-printing" characters which can be obtained from the standard keyboard of a Model 33 (or Model 35) teletypewriter. The cursor, which is visible on the screen as a character position underline, indicates the next position into which a displayable character will be entered. Each time a character is entered the cursor automatically advances one character position.

NOTE: The ASCII code for space (SP=0100000) is considered to be a displayable character, and is displayed as a blank.

Characters received from the computer have exactly the same effect on the terminal as corresponding characters entered by the operator from the keyboard. The only keyboard actions which have no direct equivalent in computer control are the function keys which are used strictly for local editing by the operator. If the computer or operator should transmit codes which do not have a defined display or control function they are simply ignored by the display.

3.3.1.2 Conversation; Full-Duplex

When operating in the Conversational Mode and set to Full-Duplex, all encoded keys on the operator's keyboard cause the corresponding ASCII characters to be transmitted to the computer, but these characters have no effect on the display screen. Characters received from the computer by the terminal have exactly the effect described in Section 3.2.2.

This mode of operation is analogous to that of a full-duplex teletypewriter.

Unencoded function keys do affect the display as previously described but cause no data to be transmitted from the terminal.

3.3.1.3 Edit Sub-Mode

When in the Conversational mode normal character-by-character transmission can be temporarily suspended and the terminal automatically placed in a special Edit sub-mode. Displayable characters may be entered by the operator but will not be transmitted to the computer. The operator is free to insert and delete characters or type over all or part of a previously transmitted line. (Note: Control characters are always transmitted in the Edit sub-mode.) When editing is completed, the operator can retransmit the edited line, automatically returning the terminal to the normal Conversational mode.

(a) Entry to Edit-Sub-Mode

The terminal automatically enters the Edit sub-mode in one of three ways:

- When the operator has started to enter data on a line and then utilizes any of the cursor controls; or
- When the operator has not started to enter data on a line but utilizes the forward cursor control; or
- When the DELETE key is depressed, or when a character is entered in conjunction with the INSERT key.

(Note: INSERT and DELETE do not trigger Edit Sub-Mode in terminals delivered after August 1, 1973.)

These logical rules insure that the Edit sub-mode is triggered only when the operator desires to edit data. They permit repositioning of the cursor from the beginning of the current line to the beginning of any other line without triggering the Edit sub-mode. Repositioning the cursor from the beginning of one line to the beginning of another is not a true editing function but is equivalent to repositioning paper on a teletypewriter for display convenience.

When the Edit sub-mode is triggered, any line on which the cursor is located will be displayed in reverse contrast; that is, white characters on a black background. The appearance of a line with reverse contrast always indicates to the operator that the terminal is in Edit Sub-Mode; it should be noted that when the Edit Sub-Mode is enabled the terminal will ignore all inputs from the computer. The Edit Sub-Mode must be cleared as described below in order for the terminal to receive data when in Conversational Mode.

The operator may experience a condition wherein the Edit Sub-Mode is triggered whenever he enters one character or whenever the computer sends one character. This situation is due to the fact that the Insert state is inadvertently enabled; the remedy is simply to press the INSERT key and thereby remove the terminal from the Insert state.

(b) Retransmission from Edit Sub-Mode

There are three ways the operator can retransmit an edited line and return to normal conversational operation:

- Press the TRANSMIT key
- Press the NEW LINE key (erasing the remainder of the line)
- Advance the cursor beyond the end of the current edited line.

If any of the three actions above occurs, the cursor automatically goes to the beginning of the current line, the entire line is transmitted with a CR code appended, and normal conversational operation is resumed. The cursor moves through each character position in the edited line as transmission proceeds and goes directly to the beginning of the bottom line after transmission has been completed.

If the edited line contains blinking (tagged) characters, an SO code is sent preceding each tagged field and an SI code follows each tagged field. Special case - if a tagged field ends with the last character in a line, the SI code is not sent.

During line transmission the Look-Ahead feature provides compressed transmission. If a blank is detected and only blanks remain from there to the end of the line, only the first blank is transmitted, a CR code is immediately sent and the cursor goes to the beginning of the bottom line.

During block transmission of a line from Edit Sub-Mode the terminal operates intrinsically in half-duplex, even if the communication mode selector switch is set to full-duplex. That is, when the block message is being transmitted the terminal will ignore data received from the computer. Immediately upon sending the CR code which terminates the line transmission the terminal can again "listen" to the computer, and the terminal reverts to the communication made corresponding to the setting of the FULL-HALF rear panel switch.

3.3.2 Page Mode

In this mode an entire page of data may be entered, edited, and then transmitted to the computer. Transmission does not take place until the terminal receives a specific transmit command from either the operator or the computer.

A Formatting feature may be used in the Page (or Message) mode. However, the description which follows is for operation with the Format feature "off". The effect of the Formatting feature is described in Section 3.4.

The display page appears stationary in the Page mode rather than scrolling (which occurs in the Conversational mode). When a character is entered in the last position of the bottom line the cursor goes to the beginning of the top line. The "home" position of the cursor is at the top left corner of the screen when in Page Mode.

3.3.2.1 Data Entry

The operator may use all editing and display control keys (Insert, Delete, Screen Erase, Horizontal Tab, New Line, Line Address sequences, Cursor Address sequences, and the five local cursor control keys) as well as alphanumeric keys to prepare a page of information. No data is transmitted to the computer before a complete page transmission is initiated. If the operator depresses the START TAG key, all subsequently entered data will appear blinking in the display. To stop entry of blinking data, the operator simply depresses the STOP TAG key. Data previously entered blinking will continue in that state until erased or altered. Any data entered as blinking data constitutes a tagged field.

Similarly, characters received from the computer cause data entry on the display page. Characters sent by the computer which have no defined function in the ADDS terminal are simply ignored. The only operator functions which cannot be exactly duplicated by the computer are the Insert and Delete functions, and five local cursor functions (Up, Down, Forward, Back, Home). Note that the computer can address the cursor to a given line and to a location within that line, and it can cause a Horizontal Tab. Thus, the computer can easily change all or any selected part of a page of information.

3.3.2.2 Data Transmission from the Page

When transmission is initiated the cursor automatically moves to the home position. Data is then transmitted, character sequential, to the computer. The cursor advances through each character position on the screen as transmission progresses and returns to the beginning of the page when transmission is completed. As the message is transmitted, Carriage Return and Line Feed codes (CR, LF) are sent after each line, and an ETX code is sent at the end of the message. An SO code is sent preceding each tagged field and an SI code is sent following each tagged field. If a tagged field ends in the last character position of line, CR, LF and then SI are sent before the first character (untagged) in the next line. Special case; If a tagged field ends with the last character on the page, no SI is sent out to terminate that field.

Transmission of a page can be initiated in three ways:

(a) When a TRANSMIT Code (Control-Q, or "DC-1" is received from the computer;

(b) When the operator depresses the TRANSMIT key;

(c) When the operator depresses the Control-Q key.

Transmission time is conserved by a feature that suppresses trailing blanks within each line. For example, if the last data character in a line is the letter R and there are 20 blanks between that character and the end of the line, the line will look like the character sequence

. . . R, SP, CR, LF

when the message is transmitted. That is, only the first blank in a group of trailing blanks is transmitted. If a line is completely blank, the terminal will transmit the three-character sequence

SP, CR, LF

for that line.

During a Page transmission from the terminal, inputs from the computer are ignored. After sending the ETX page transmission terminator, the terminal again can receive data from the computer.

3.3.3 Message Mode

The Message Mode can be considered a subset of the Page Mode. Data is entered into the display page by either the operator or the computer in exactly the same way in Message Mode as was described above for Page Mode.

However, the Page and Message modes differ in the manner in which data is transmitted from the terminal to the computer.

Message Mode permits transmission of a page (or any part of a page) as a sequence of line transmissions. This makes it easy to do selective transmission and also makes transmission of a page compatible with any currently available time-sharing software which basically processes data as a series of line messages rather than as one large block of data.

The rule for transmission in Message Mode is: Upon depression of the Transmit key (or Control-Q),

(a) The cursor goes automatically to the beginning of the current line.

(b) The line is transmitted as a serial stream of characters. Certain special characters are inserted in the character string. (SO and SI to delimit tagged fields if unprotected; GS to indicate skipped protected fields if in the protected state.)

(c) Trailing blanks are suppressed (except for the first blank of a trailing field), and

(d) The CR code is transmitted to indicate the end of the line, and the cursor stops at the beginning of the next line.

The line transmitting sequence listed above is initiated in one of three ways:

(a) A DC1 (Control-Q) code from the computer, or

(b) Depressing the TRANSMIT key on the CONSUL keyboard, or

(c) Depressing Control-Q on the CONSUL keyboard.

Thus the computer or the operator can position the cursor to a particular line and cause that line (and following lines) to be transmitted by issuing a Transmit Code (or a sequence of Transmit codes).

3.4 Protected Data and FORMAT Control

When the terminal is in the Page or Message mode, a Formatting feature allows the display of both fixed and variable data. This feature is used primarily to display forms on the screen, thus making data entry easier and faster for the operator and also assuring that all necessary data is entered.

Note: Terminals delivered after July 1, 1972 also permit the use of forms and protected data in Conversational mode. This must be used with regard to certain restrictions; see Section 3.4.3 for details.

The Format feature is either "on" or "off" and is operator-controlled by use of the FORMAT ON and FORMAT OFF keys on the keyboard. It can be computer-controlled by means of the Record Separator (RS) code for FORMAT ON, and by the Unit Separator (US) code for FORMAT OFF.

3.4.1 Format Off

As described earlier, with the Format feature "off", data can be entered in all character locations. If the operator depresses the START TAG key all subsequently entered data will blink. To stop the entry of blinking data, the operator must depress the STOP TAG key. Therefore, by using the START TAG and STOP TAG keys the operator can display a page with some data blinking and other data displayed normally. The blinking data between a START and STOP TAG is called a tagged field.

During transmission of the Page or Message each tagged field is preceded by a Shift Out (SO) code and followed by a Shift In (SI) code. The computer controls entry of tagged data fields by using an SO character for Start Tag and an SI character for Stop Tag, similarly to the method used by the operator via the keyboard.

3.4.2 Format On

When the operator depresses the FORMAT ON key or the computer sends RS, tagged fields change appearance from blinking to half intensity. In the FORMAT ON state tagged data is not accessible and is considered "unprotected". The cursor skips over all protected data preventing it from being addressed, written over, or transmitted.

3.4.2.1 Data Entry

Data is entered normally. However, if a character is entered in the last character position of an unprotected field, the cursor automatically skips over the intervening protected field and stops at the next unprotected character location.

3.4.2.2 Control Functions

In a similar fashion, control functions will not disturb protected data. For example, the Erase function causes only unprotected data to be erased and places the cursor at the first unprotected location on the page; New Line erases only the remaining unprotected data on the current line and places the cursor at the first unprotected location on the next line.

With the Format feature "on", Horizontal Tab does not move the cursor between the normal fixed tab stops. Rather, it moves the cursor to the first location of the next unprotected field.

3.4.2.3 Data Transmission

When transmission is initiated in Page Mode, the cursor automatically goes to the beginning of the page and then proceeds to transmit all the variable data in the normal character sequential manner. Within the transmitted character string a Group Separator (GS) code is inserted for each protected field that was encountered and skipped, and (CR, LF) codes are inserted to denote the end of each display line. An ETX code is also appended at the end of the complete page. At low transmission speeds the cursor can be observed moving on the page as transmission proceeds. It stops at the first unprotected character location on the page after transmission.

When transmission is initiated in Message Mode the principal difference is that only the current line is sent. The cursor automatically goes to the beginning of the line and then proceeds to transmit all variable data in the normal character sequential manner. The GS code is inserted as usual to indicate protected fields. When the cursor reaches the end of the line a CR code is inserted in the transmitted string (no LF is sent as is done in Page Mode), the cursor proceeds to the first variable position of the next line and the transmission is stopped. Note that if the next line starts with a protected field a GS code will be sent as the first character of the next line when (or if) the

line is sent.

In either Page or Message mode the Look-Ahead feature suppresses the trailing blanks at the end of a line for optimum transmission efficiency. That is, only the first blank from a group of trailing blanks is transmitted. For example, assume that at the end of a line we have the following sequence:

. . . D, SP, SP, SP (five protected characters)

SP, E, F, G, SP, SP, SP, SP, SP

In FORMAT ON state we will transmit:

. . . D, SP, SP, SP, GS, SP, E, F, G, SP, CR, LF, (LF not sent in Message Mode)

Note that if a tagged field extends to or through the end of a line, the GS code is sent before CR, LF.

Note also that in the transmission sequences shown above the commas between characters are for annotation only. They are not sent by the terminal.

When a protected field terminates a line and subsequent lines are fully protected, only the first line terminator sequence (CR, LF) is sent in that part of the data stream.

As an illustration, consider a case in which we have a group of four lines on the display page as follows:

line 1 - . . . . A, SP, (protected field)
line 2 - (Fully protected)
line 3 - (Fully protected)
line 4 - (Protected field), B, C, . . .

Upon transmission the terminal sends

A, SP, GS, CR, LF, B, C

As a second illustration, consider the case in which the end of a line is protected and all lines from that point to the end of the page are completely protected. The resulting ASCII character string is

. . . , GS, CR, LF, ETX.

3.4.3 Protected Data in Conversational Mode

Effective July 1, 1972 protected data is permitted in Conversational mode.

As before, tagged data fields are preceded by the SO character and terminated by the SI character.

Previously, tagged data could only blink in Conversational mode and not be protected. However, tagged data will now have protection capability, exactly as in Page and Message mode:

Format On (RS) - causes tagged data to be protected and shown at half intensity

Format Off (US) - causes tagged data to be unprotected and displayed blinking

There are certain restrictions on protected data in Conversational mode of which a user should be aware:

(a) If there is protected data on the screen and a Horizontal Tab (HT) is issued, the display could go into a continuous scroll. The reason is that, when protection is enabled and an HT occurs, the cursor skips forward looking for the beginning of the next variable data field. If the cursor should skip past the end of the last line due to an HT when the Conversational mode and protection are simultaneously enabled, an automatic scroll occurs and the cursor will keep searching and causing further scrolls.

(b) When Edit sub-mode is enabled, protected data (normally at half-intensity) turns completely dark. Note: Retransmission from Edit sub-mode follows the transmission rules for Message mode.

Due to these restrictions we anticipate most users will continue to employ Page or Message mode for protected data and will not use protected data in Conversational mode. Programmers must be aware of this feature and must take care to avoid accidental generation of protected data in Conversational mode. For example, initialization routines which clear the screen should be preceded by the US code.

Similarly, if a user wishes to cause graphics presentations in Conversational mode and then cause those characters to blink he would use Control-Y to enable Graphics mode and Format Off (US) to change graphics characters to blinking characters. (Making sure not to use Format On (RS) to terminate graphics generation.)

With cautionary comments above in mind, a user may decide to use the data protection feature in Conversational mode; especially if he uses Full-Duplex so that only the computer (and not the operator) can issue HT codes to the display.

3.5 The Graphics Option

Graphics capability can be supplied with any ADDS terminal which has a memory organization of 24 X 80. (24 lines X 80 characters per line). With this feature the terminal can simultaneously display graphic and alphanumeric characters.

3.5.1 General Description

A terminal with the graphics feature is set to the graphics mode when it receives the ASCII control code EM from the computer or the keyboard (EM is generated at the keyboard as Control-Y.) In this mode "tagged" characters are treated as graphic characters and are displayed as described below, and untagged characters are displayed as the usual alphanumeric characters. Thus, simultaneous presentation of graphic and alphanumeric characters is possible. The terminal leaves the graphics mode upon receiving either ASCII Control Code RS or US. ("FORMAT ON" or "FORMAT OFF")

Normally the "tag" bit is the seventh bit that is appended to 6-bit alphanumeric characters to control protected format information. When the graphics mode is enabled (by use of code EM), the tag bit is used to control generation of graphics rather than controlling access protection.

Graphic characters consist of small rectangles which are sharply defined since they are formed by actually blanking the video signal, rather than by generating dot patterns. Resolution for graphics generation is 160 horizontal elements X 72 vertical elements, covering the display page.

3.5.2 Graphic Character Generation

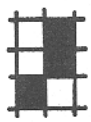
A character position can be thought of as containing any combination of up to six elements. The elements positions are numbered as follows:

1	2
3	4
5	6

Graphic tagged characters are interpreted as follows:

Bit 1 = 1 means darken element 1
Bit 2 = 1 means darken element 2
Bit 3 = 1 means darken element 3
Bit 4 = 1 means darken element 4
Bit 5 = 1 means darken element 5
Bit 6 = 1 means darken element 6

Some ASCII codes for alphanumerics are shown as they would be displayed as tagged graphic characters.

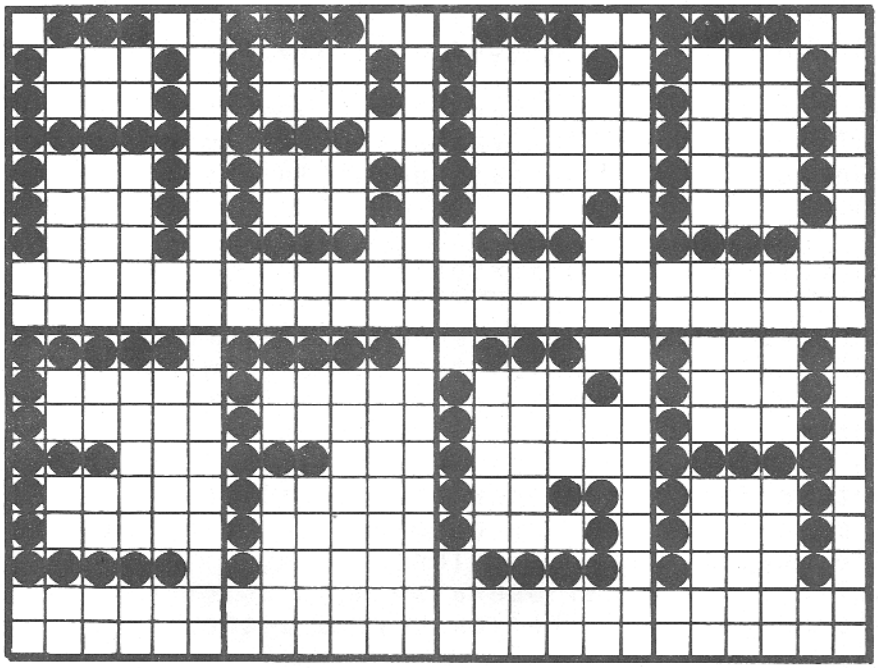
	b_7	b_6	b_5	b_4	b_3	b_2	b_1	
T	1	0	1	0	1	0	0	
9	0	1	1	1	0	0	1	
Z	1	0	1	1	0	1	0	
K	1	0	0	1	0	1	1	

Thus, graphic characters displayed on the same line can generate solid horizontal lines

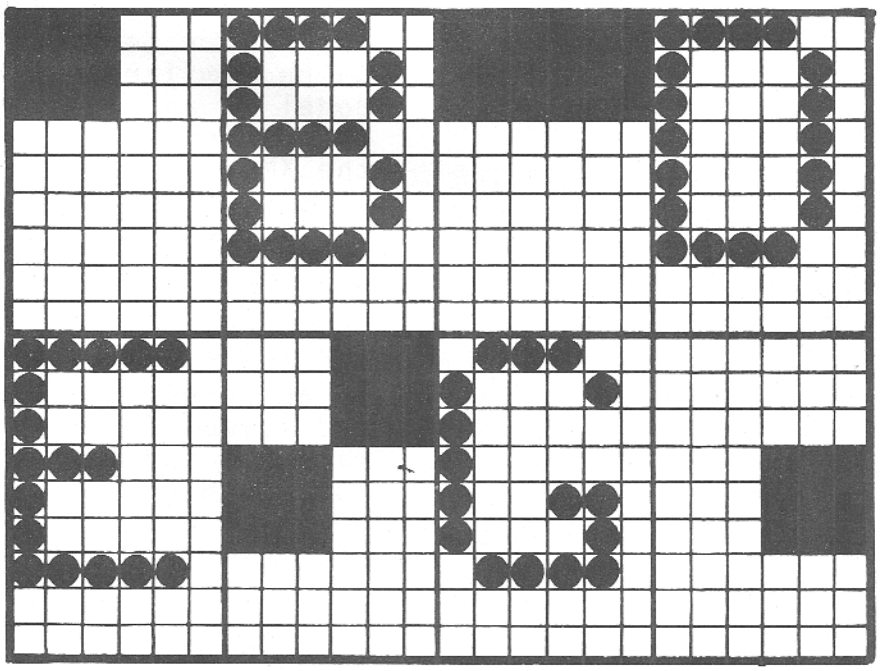
Or, graphic characters displayed in the same column can generate solid vertical lines.

Fig. 3-2

NOTE THAT WE NORMALLY FORM CHARACTERS AS A 5x7 DOT MATRIX WITHIN A 6x9 CHARACTER SPACE SUCH AS:



IF THE LETTERS A, C, F AND H ABOVE ARE WRITTEN WITH A TAG BIT AND THE TERMINAL PLACED IN GRAPHICS MODE WE HAVE:



SINCE
A=1000001
C=1000011
F=1000110
H=1001000

3.6 Keyboard Description

The keyboard, shown in Figure 3.3, is designed to assist the operator in distinguishing the various operations which can be performed and to minimize required training. The keyboard is an integral part of the CONSUL series of terminals; it is also provided in a free-standing enclosure which connects to MRD-700 series terminals via cables.

Several versions of keyboards have been installed in ADDS terminals; however, the variations are minor and will be mentioned at the appropriate point in the following discussion.

3.6.1 General Keyboard Description

The keyboard layout is shown in Figure 3.4, with an ASCII code chart below the scale drawing of the keyboard. The keyboard is arranged so that there are three separate sections which differ in function. Furthermore, keytops are in two colors (orange and yellow are standard) to further facilitate operator identification. All keys which are utilized by an operator in a manner similar to a teletypewriter are colored orange. All keys which are utilized for local operator editing or control are colored yellow. (Yellow keys are shown shaded in Figure 3.4).

The three sections of the keyboard are (left to right in Figure 3.4):

Typing array: A group of 54 keys arranged in the standard off-set used for typewriters and layed out to be similar to the familiar Model 33 and 35 teletypewriter. This array also includes the XMIT and SCREEN ERASE keys (yellow) for easy operator access.

Block Numeric pad: An eleven key pad containing the digits 0 through 9 and a "." (period) key. This key is arranged in the ANSI standard layout for 10-key adding machines and is normally used for rapid data entry.

KEYBOARD

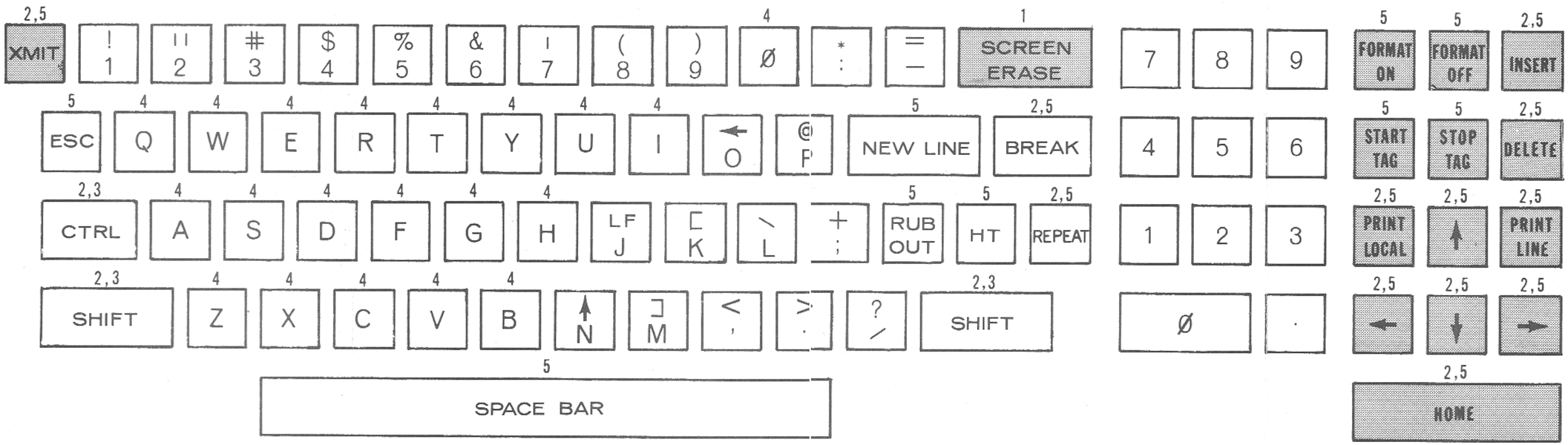
Fig. 3-3

NOTES:

1. Must be used in conjunction with "CONTROL".
2. Produce D.C. level change, not coded.
3. Used to control keyboard operating modes.
4. Not affected by "SHIFT".
5. Not affected by "SHIFT" and "CONTROL".

KEYBOARD LAYOUT & ASCII CODE CHART

Fig. 3-4



b7 → / b6 → / b5 → / b4	b3	b2	b1	col / ROW
Ø	Ø	Ø	Ø	Ø
Ø	Ø	Ø	1	1
Ø	Ø	1	Ø	2
Ø	Ø	1	1	3
Ø	1	Ø	Ø	4
Ø	1	Ø	1	5
Ø	1	1	Ø	6
Ø	1	1	1	7
1	Ø	Ø	Ø	8
1	Ø	Ø	1	9
1	Ø	1	Ø	1Ø
1	Ø	1	1	11
1	1	Ø	Ø	12
1	1	Ø	1	13
1	1	1	Ø	14
1	1	1	1	15

CONTROL

Ø Ø Ø	Ø Ø 1
Ø	1
NUL	DLE
SOH	DC1
STX	DC2
ETX	DC3
EOT	DC4
ENQ	NAK
ACK	SYN
BEL	ETB
BS	CAN
HT	EM
LF	SUB
VT	ESC
FF	FS
CR	GS
SO	RS
SI	US

DISPLAYABLE CHARACTERS

Ø 1 Ø	Ø 1 1	1 Ø Ø	1 Ø 1
2	3	4	5
SPACE	Ø	@	P
!	1	A	Q
QUOTE "	2	B	R
#	3	C	S
$	4	D	T
%	5	E	U
&	6	F	V
APOS. '	7	G	W
(	8	H	X
)	9	I	Y
*	:	J	Z
+	;	K	[
COMMA ,	<	L	\
MINUS —	=	M	]
PERIOD .	>	N	↑
/	?	O	←

NON-DISPLAYABLE

1 1 Ø	1 1 1
6	7
`	p
a	q
b	r
c	s
d	t
e	u
f	v
g	w
h	x
i	y
j	z
k	{
l	:
m	}
n	~
o	DEL

Control and Editing array: These 13 yellow keys provide the operator with the means to move the cursor up, down, forward, back or home (indicated by the keytop labels), to Insert or Delete characters, to control data entry in the blinking or protected state (START/STOP TAG and FORMAT ON/OFF), and to control local peripherals via the PRINT LINE and PRINT LOCAL keys.

Note: Special attention should be given to the INSERT and PRINT LINE keys which differ from all the other keys on the keyboard. These keys are called Alternate Action Keys (sometimes referred to as "Push-Push" keys). One depression activates the Insert or Print Line function. A second depression deactivates the associated function.

Depending on the exact version of keyboard these Alternate Action keys may be any of three types. (Note that regardless of the type, the result is the same and the operation of the key is the same)

(a) Mechanical Lock, non-lighted. The key mechanically locks in the depressed position when struck. A second strike releases it to the non-depressed or "UP" position.

(b) Mechanical Lock, lighted. The same as above except that the keytop is lighted when in the depressed position to further aid in recognition of this fact.

(c) No Lock, lighted. This type has a keytop which is lighted when initially depressed and the light is extinguished when depressed the second time. The key itself does not lock in the depressed position.

3.6.2 Keyboard Code Generation

The lower half of Figure 3.4 shows a conventionally arranged ASCII code chart, divided into three sections corresponding to:

(a) Control codes - these characters are not displayable. Some of them do affect the state of the terminal, as described earlier. (columns Ø and 1 of the chart)

(b) Displayable characters - the 64 upper-case alphanumerics which are displayed on ADDS terminals. This set is sometimes called "Compressed ASCII." (columns 2, 3, 4 and 5 of the chart)

(c) Non-Displayable characters - these are the lower-case characters which are not displayed by ADDS terminals. (columns 6 and 7 of the code chart) If they are received, they are automatically translated and displayed as their upper-case equivalent; they cannot be generated from the ADDS keyboard. The only exception to this is the code DEL, in the lower right corner of the table. When this code is received it is simply ignored. It can be generated from the keyboard by means of the RUBOUT key.

A brief discussion is in order on how to read the table. For convenience, the binary code for each character is divided into two parts, a four-bit number representing the four least significant bits (b1, b2, b3, b4) and a three-bit number representing the three most significant bits (b5, b6, b7). Thus, the chart is divided into 8 Columns designated by b5, b6, and b7 and 16 Rows designated by b1, b2, b3 and b4. This offers two ways of indicating a particular character's code: either as a seven-bit binary number or as a Column/Row number in decimal notation. For example, the character M represents the binary number 1001101 or the alternative 4/13 notation. Similarly, the control code VT represents the code 0001011 or the alternative Ø/11 notation.

Another technical point one should know in using the keyboard to generate ASCII codes is the use of the CONTROL and SHIFT keys in the alphanumeric (teletypewriter) array. The SHIFT key inverts bit 5 and the CONTROL key forces bit 7 to a zero. (Certain encoded keys are not affected by SHIFT or CONTROL, as indicated by notes in Figure 3.4. This is in accordance with standard teletypewriter usage.) A number of examples follow:

Example 1; The code Line Feed can be generated as Control-J. Note that the code for J (4/10) is changed to the code for LF (Ø/10) when bit 7 is changed from one to zero.

Example 2: The RS code (1/14) can be generated as Control-N since CONTROL forces bit 7 in the code for N (4/14) to a zero. Furthermode, Control-Shift-N generates code RS (1/14) because tne added effect of the SHIFT key inverts bit 5.

Note the alphanumeric keys labeled HT, NEW LINE, RUBOUT, and ESC. These keys generate the codes associated with their keytop labels. NEW LINE generates the ASCII character CR, found in Column Ø Row 13. The RUBOUT key generates the ASCII DEL code (7/15). The key SCREEN ERASE generates code FF (Ø/12) but must be used in conjunction with the CONTROL key; this is to present inadverdent erasure of the display by the operator.

The four encoded keys in the Control array (FORMAT ON, FORMAT OFF, START TAG, STOP TAG) permit easy generation of certain codes which are used by the ADDS terminal, without requiring use of the CONTROL or SHIFT key.

- FORMAT ON generates code RS
- FORMAT OFF generates code US
- START TAG generates code SO
- STOP TAG generates code SI

A special key is the BREAK key, which acts like the corresponding teletypewriter key. It causes a "long space" condition, which lasts 200 milliseconds, on the serial data line out of the terminal.

3.7 Connecting the Terminal to Your System

The terminal can communicate with a computer in a variety of ways, depending on which options have been ordered:

- Serial via a built-in modem, or
- Serial - EIA/TTY, or
- Parallel

3.7.1 Modem Connection (CONSUL series only)

The built-in modem option affords acoustic communication over a telephone line. Set the BAUD RATE selector switch to either 110 or 300 baud. The telephone handset should be placed on the acoustic pad which comes with the CONSUL. Most users dial a computer, listen for the correct tone, and then place the handset on the acoustic pad. However, the handset could be positioned on the acoustic pad before dialing. The CARRIER indicator on the front panel will illuminate when communication has been established between the user's telephone and the remote computer.

3.7.2 Serial EIA/TTY Connection

The terminal can communicate serially with Bell System 103 datasets or other types of EIA-compatible equipment. The BAUD RATE switch at the rear panel may be set to 110, 300, 1200, 1800, or 2400 baud transmission rate.

Note that the speed selector switch on the rear panel is labeled 110, 300, 1200, A, B. Normally, speed A is 1800 baud and speed B is 2400 baud. If you have ordered a special speed on your terminal it will be assigned to A or B and will replace the corresponding standard speed.

Optionally, a TTY-compatible 20 MA "current loop" interface may be provided in addition to the normal EIA voltage interface.

Details of the connector pin assignments and electrical characteristics of this interface are presented in Section 4.3.1. For most applications the user does not have to be aware of such details; he must simply connect a jumper cable with a 25-pin connector at both ends (Cinch or Cannon type DB-25P) between his equipment and the ADDS terminal, jumpering pin 7 to pin 1 within the cable.

When connecting to equipment other than a type 103 Dataset or 103-compatible device Section 4.3.1 should be consulted for details. Note especially the send-receive convention (pins 2 and 3) at this interface.

3.7.3 Parallel Connection

If the terminal is ordered with a parallel interface characters are transferred in and out in bit-parallel fashion. See Section 4.3.2 for details of this interface.

It is important to note that all such parallel transfers are done on a "request-acknowledge" basis so that pin 3 on Parallel I/O Connector A (the line labeled External Device Busy) must be jumpered to pin 4 of that same connector (labeled Character Ready) if you want to transmit data from a parallel terminal when it is off-line. Otherwise it appears to the terminal that the first character transmitted has not been received and the display cursor will not move and additional characters cannot be transmitted until it appears that an acknowledgment has been received.

3.8 Connecting Peripheral Equipment

If your terminal has been equipped with the Printer/Cassette Interface Option, the ADDS Printer and Cassette Recorder may be plugged into the rear panel. Note that associated with the two connectors for these peripherals are two ON-OFF toggle switches. When a peripheral is plugged in and it is to be operated, the associated switch must be in the ON position. When a peripheral is not plugged in (or when it is to be placed in an "off-line" state) the associated toggle switch must be OFF.

> NOTE: When a peripheral device is pushed into or pulled out of its terminal rear panel connector, the individual Power switch on that peripheral must be OFF to prevent possible damage to the terminal electronics.

Refer to the manuals provided with each peripheral device for details of their operation.

The Cassette Recorder interface is bidirectional; it provides serial EIA data out of the terminal and accepts similar input data. The Printer interface is unidirectional, providing parallel TTL output data. See Section 4.3.3 for details.

4. INTERFACING ADDS TERMINALS

4.1 Introduction

ADDS terminals offer a variety of interfaces which are described in this Section. Connector pin assignments, interface signal descriptions, and cable design practice are presented in sufficient detail to enable the systems engineer to design interfaces between his own equipment and ADDS terminals.

Two series of terminals may be interfaced:

(a) The Consul series (Models 880 and 840): desktop CRT terminals with built-in keyboards and TV monitors, featuring TTY compatibility and powerful editing and formatting capability.

(b) The MRD-700 series (Models 780 and 740): Rack-mountable units which contain the same electronics as the Consul series. The user can build customized systems by connecting his own keyboard and TV monitor to the MRD-700, or he can purchase keyboards and monitors from ADDS which plug into the MRD-700 electronics package. (Switches on the rear panel of the MRD-700 are used for mode selection and the data rate, which are controlled from the front panel of the Consul terminal.)

4.2 Connector Complement

4.2.1 Video Output

One BNC connector is provided from which EIA-standard (RS-170) composite video can be fed via 75-Ohm coaxial cable to TV monitors.

4.2.2 Data Connectors

All data connectors are 25-pin rack-and-panel type. Female connectors (Cinch or Cannon DB-25S) are mounted on the rear panel of the terminal. User cables should be terminated in the corresponding male connector (Cinch or Cannon DB-25P). Male connectors are shipped with the terminal - one for each female connector on the rear panel.

The number of connectors depends on options which have been ordered. Connector quantities follow:

(a) Keyboard Connector (two each)

Provided only on an MRD-700

(b) Serial EIA/TTY Input/Output Connector (one each)

(c) Parallel I/O Connectors (two each)

Used for bit-parallel data transfers, such as to and from a computer parallel bus.

> NOTE: Normally (b) and (c) above are mutually exclusive. That is, the terminal comes with either one or two data communication connectors depending on whether the serial or parallel interface has been ordered.

(d) Printer/Cassette Interface (two each)

These two connectors are provided only if the Printer/Cassette Option has been ordered. (One connector is used for parallel output to a printer and the other as a serial EIA/TTY connection to and from the ADDS Cassette Recorder or other EIA-compatible device.)

4.3 Interface Description

4.3.1 Serial EIA/TTY Interface

Serial data is transmitted to and from the terminal via this interface. The data format is asynchronous, with start and stop bits for each character.

The speed of transmission is selected by means of a five-position switch. Standard speeds are:

110	Baud
300	"
1200	"
1800	"
2400	"

The five speeds above are equivalent to speeds of 10, 30, 120, 180, and 240 characters per second.

Table 4.1 gives the pin assignments for this data connector. Note that pins not assigned by EIA (RS-232B) are used to interface teleprinter "current loop" devices. If the TTY current-loop option is ordered, an additional P.C. card is inserted in the terminal electronics and Pins 11, 18, 21 and 25 are used to interface current-loop devices as shown in Table 4.1. In this manner either an EIA (RS-232B) voltage interface may be used or a TTY current-loop interface, but not both at the same time.

The Request to Send signal and Clear to Send Signal are used to control the transmit function, and operate as follows:

Full-Duplex. In full-duplex transmission the Request to Send Line is always high. When used with a data set (modem) the Clear to Send is generally made high when the carrier is being placed on the transmitter line. When both Request to Send and Clear to Send are high, the terminal transmits.

Note that when a direct connection is made to a customer's device, the customer can control transmission by using the Clear to Send Line as an Enable Transmission signal.

Half-Duplex. When in half-duplex the terminal raises Request to Send when the first character is ready for transmission. When Clear to Send goes high, the first character is transmitted. Request to Send remains high until the CR character is sent, at which time the Request to Send is dropped.

A customer direct interface may control transmission in half-duplex by controlling Clear to Send in the same way as in full-duplex.

Table 4.1

EIA/TTY PIN ASSIGNMENTS

Pin	EIA Circuit Name	Assignment
1	AA	Protective Ground *
2	BA	Transmitted Data (from terminal)
3	BB	Received Data (to terminal)
4	CA	Request to Send (from terminal)
5	CB	Clear to Send (to terminal)
7	AB	Signal Ground *
8	CF	Data Carrier Detector (to terminal)
11	-	+ Current-loop input to the terminal; 20 MA current (Mark) closes relay and no current is a Space.
18	-	-
20	CD	Data Terminal Ready (from terminal)
21	-	- Relay contact output from terminal for current-loop devices. Mark is closed contacts, and Space is open contacts. These contacts are rated for 20 MA.
25	-	+

EIA data signals to the terminal (Pin 3) can be in the range:

+3 volts to +25 volts for Space
-3 volts to -25 volts for Mark

EIA control signal to the terminal (Pins 5, 8) can be in the range:

+3 to +25 volts for signal detection
-3 to -25 volts for non-detection

EIA transmitted data from the terminal (Pin 2) is:

+13 volts for Space
-13 volts for Mark

EIA control signals from the terminal (Pins 4, 20) are:

+13 volts

* NOTE: Pin 1 must be jumpered to Pin 7 within the connecting cable.

NOTE

TTL voltage levels are assumed in following section:

High	+4.0	±1.5 volts
Low	+0.2	±0.2 volts

4.3.2 Parallel Input/Output

4.3.2.1 General Description

A terminal may be ordered with parallel input/output rather than a serial interface. When the parallel interface is provided characters are transferred to or from the terminal as parallel 7-bit ASCII characters (with an optional 8th parity bit). This type of interface is commonly used for hard-wired connection to a computer data bus, data acquisition system, etc.

Transfers via the Parallel I/O Interface are accomplished by a "hand-shaking" (request-response) sequence. It should be noted that the Baud Rate selector switch, which is used to select data rates for serial transmission, has no effect on a terminal with Parallel I/O. By means of the request-response sequences data can be transferred as rapidly as internal terminal access times. (Approximately a 1.4 KC character transfer rate)

NOTE: The request-response technique method of data transfers implies that when a terminal is operated "off-line" (i.e. disconnected from the system with which it normally operates) and attempts to transmit a block of data, only the first character of the block will be transmitted and the terminal will not send subsequent characters because no response has yet been received to the first character. In other words, the terminal appears to "hang" after the first character of a block transfer initiated in PAGE or MESSAGE mode, or after the first character sent in CONVERSATIONAL mode. This condition can be avoided for off-line testing or demonstration of a parallel terminal by jumpering Pin A-4 to Pin A-3. (See Table 4-2) If the jumper connection is made block output occurs at the maximum terminal speed.

4.3.2.2 Interface Signal Description

Data at this interface assumes "positive" logic. That is,

logical 1 = voltage high
logical 0 = voltage low

a) Input to the terminal

Seven (or eight) Data Lines

- B1 through B7 standard ASCII
- Optional even or odd parity*

One Input Strobe Line

- True Pulse (high)
- Should occur a minimum of 500 nsec. after Input Data lines become stable
- Minimum width: 500 nsec.

One Terminal Response Line (labeled "Terminal Busy")

- True (high) signal occurring a minimum of 700 nsec. after leading edge of Input Strobe
- Input data must be stable until a minimum of 500 nsec. after Terminal Busy goes high
- No access may be made during Terminal Busy High

b) Output from the Terminal

Seven (or eight) Data Lines

- 7 or 8 lines (with optional parity bit)
- B1 through B7 standard ASCII
- Optional Even or Odd parity generated. If unspecified, B8 will be high
- Becomes stable minimum 10 **usec**. before character ready

One Character Ready Line

- True pulse (high)
- Remains High until external device responds with External Device Busy.

*If input parity is wrong a "space" is written; if input parity is not specified, no check is performed.

At this time the Character Ready signal goes low and remains low until External Device Busy falls, at which time the terminal can output another character.

*One External Device Busy Line

- True signal (high)

- The external device should respond to the Character Ready Signal with a high level after latching the character. This signal should return low when the next character is desired. This line should remain high for a minimum of 600 nsec. and remain low for a minimum of 600 nsec.

Note:

The "External Device Busy" should be low for all input operations to the terminal, and should go high only when accepting a character being output from the terminal.

*If the terminal is equipped with the Printer/Cassette Option and is in the PRINT ON-LINE state, minimum time high is 50 usec. and minimum low time is 10 usec.

Timing Restriction for Cursor Addressing; Parallel Terminals

A timing restriction exists when using cursor addressing on a parallel terminal.

The formula for determining how much time to wait between the last character of the four character cursor addressing sequence and the next character which will be accepted by the terminal is:

Wait Time = 1.2n microseconds, where "n" is the decimal number sent as the last two characters of the cursor addressing sequence.

Explanation of Restriction

The four character sequence ESC-ENQ-A10'-A10^{o} each cause the Ready/Busy line to go through the usual transition from Ready to Busy and back to Ready. However, the cursor does not start to move until the A10^{o} character has been interpreted, which is the same time that the terminal becomes Ready. The cursor is clocked at a rate of 1.2 microseconds per position. Therefore, the greater the magnitude of A10' A10^{o} (the further the cursor is advanced), the longer the external device must wait before input will be recognized. (The input is locked out until the cursor move is completed.) The maximum time, for 100 character positions, is 1.2 x 100 = 120 microseconds.

Table 4.2
PARALLEL I/O PIN ASSIGNMENTS

Parallel Data Connector A

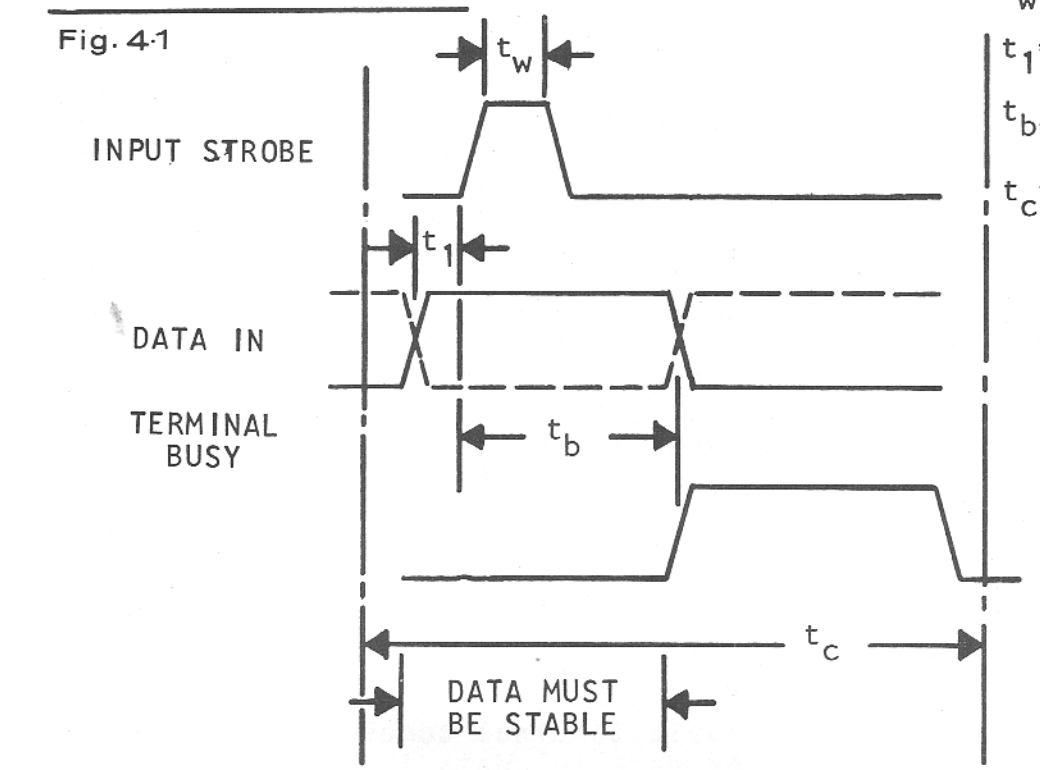
Pin	Signal	Pin	Signal
1	Input Strobe	14	Input Strobe
2	Terminal Busy	15	Terminal Busy Gnd
3	Ext Device Busy	16	Ext Device Busy Gnd
4	Character Ready	17	Character Ready Gnd
5	B1 Input	18	Chassis Gnd
6	B2 Input	19	"
7	B3 Input	20	"
8	B4 Input	21	"
9	B5 Input	22	"
10	B6 Input	23	"
11	B7 Input	24	"
12	Parity Input	25	"
13	NC		

Parallel Data Connector B

1	B1 Output	14	Chassis Gnd
2	B2 Output	15	"
3	B3 Output	16	"
4	B4 Output	17	"
5	B5 Output	18	"
6	B6 Output	19	"
7	B7 Output	20	"
8	Parity Output	21	"
9	NC	22	"
10	NC	23	"
11	NC	24	"
12	NC	25	"
13	NC		

PARALLEL INPUT TIMING

Fig. 4-1



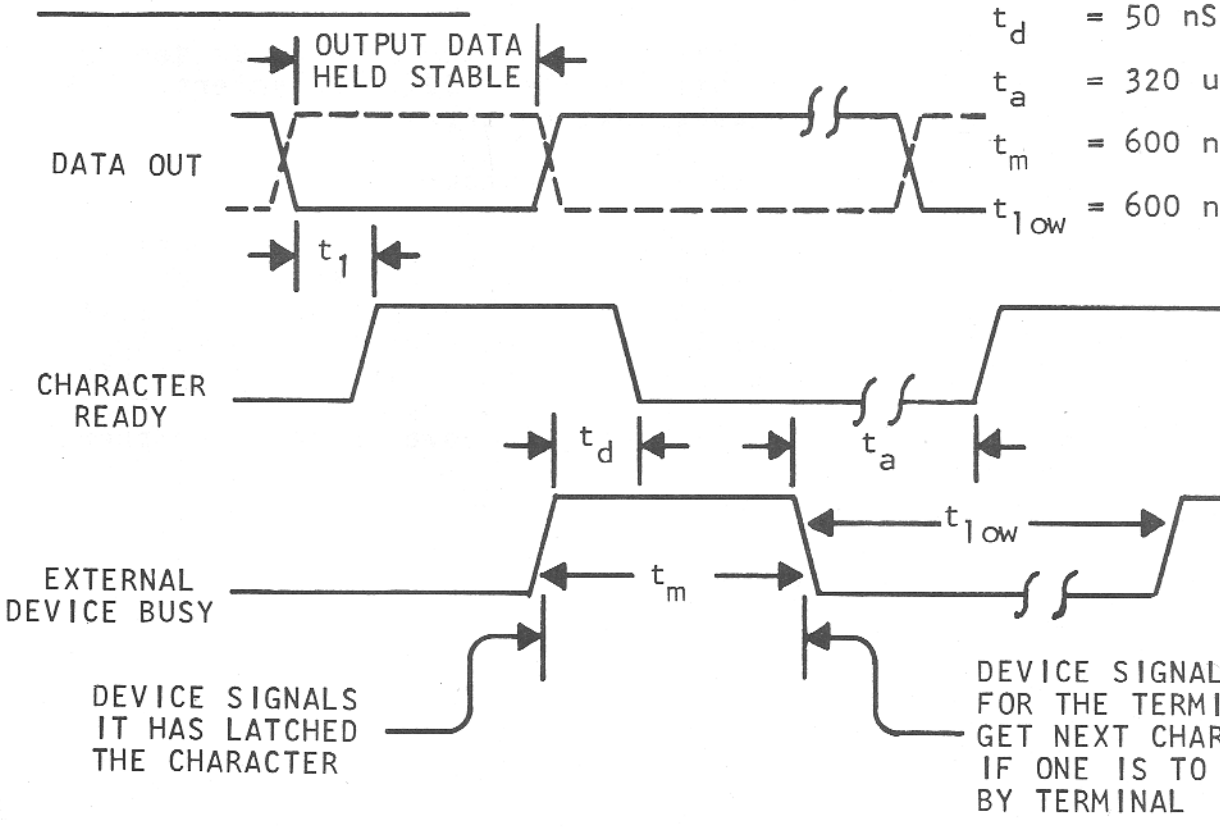
t_w=500 nSEC MIN.

t_1=500 nSEC MIN.

t_b=1-2 uSEC TYP.

t_c=320 uSEC TYP.

PARALLEL OUTPUT TIMING



t_1 = 10 uSEC MIN.

t_d = 50 nSEC TYP.

t_a = 320 uSEC TYP.

t_m = 600 nSEC MIN.

t_{low} = 600 nSEC MIN.

4.3.3 Printer/Cassette Interface

4.3.3.1 Overall Configuration

The primary function of this interface is to accept the ADDS tape Cassette Recorder/Reproducer and thermal printer. A user need only plug these devices into the terminal with cables supplied by ADDS and does not have to be concerned with details of the interface.

However, the systems designer can use this flexible interface as a "second port" to the CRT terminal. For example, if a terminal is equipped with the Printer/Cassette Interface, data can be acquired from one system by the CRT, edited by the operator and then transmitted to a different system.

As another example, data can be read into the terminal via the cassette connector and can be simultaneously output to the printer to achieve a "Local Listing."

To clarify concepts and nomenclature please refer to Figure 4.2. The basic terminal comes with either a serial (EIA/TTY) or parallel data interface. For purposes of discussion let us call this the "Processor" interface. When the Printer/Cassette Interface option is ordered additional interfaces are provided for:

a) Printer (Parallel) Output

   Suitable for driving a printer or similar device which accepts bit-parallel ASCII characters. The ADDS printer uses this interface.

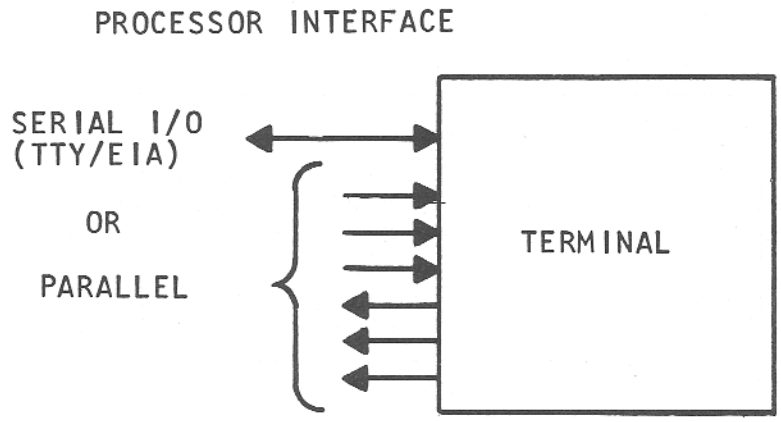
b) Cassette (Serial) Input/Output

   Suitable for sending information to, or receiving data from ASCII-coded serial devices such as teleprinters, incremental tape drives, and ASCII-coded instrumentation. The ADDS tape Cassette Recorder/Reproducer is plugged into this interface.

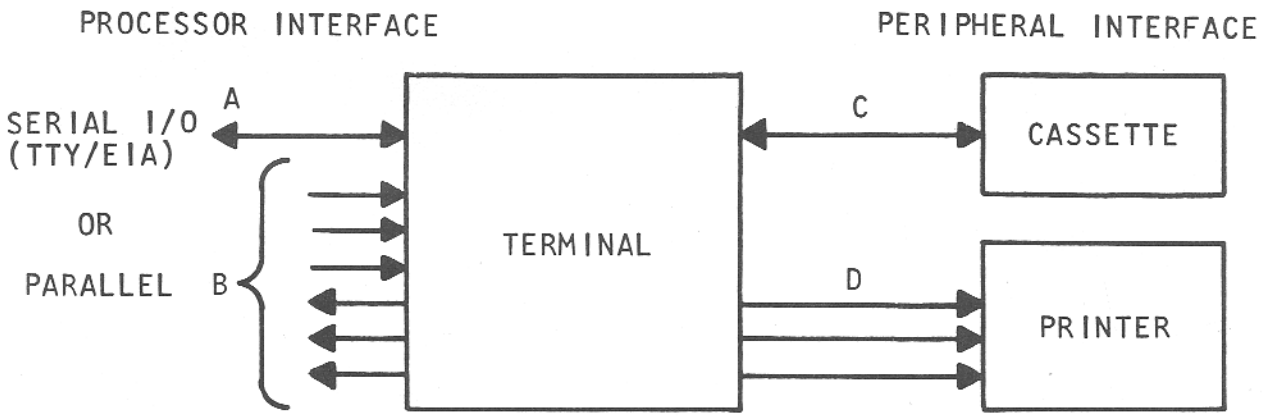
We shall refer to (a) and (b) above as the "peripheral" interface.

BASIC TERMINAL INTERFACE

Fig.4-2



BASIC TERMINAL PLUS PRINTER/CASSETTE OPTION



POSSIBLE INTERFACE COMBINATIONS	
PROCESSOR	PERIPHERAL
A	C AND D
B	D ONLY

Note: If a terminal is ordered with a serial processor interface, the peripheral interface will accommodate both a cassette and a printer.

However, if a terminal is ordered with a parallel processor interface, the peripheral interface will support only a printer and not a cassette.

4.3.3.2 Peripheral Data Flow

Two keys on the terminal keyboard control the method of transferring data to (and from) the peripheral interface, as described below.

(a) PRINT ON-LINE

This is an alternate action key ("push-to-set" and "push-to-reset"). In the PRINT ON-LINE state, the printer and cassette receive data in two ways:

(1) The peripherals receive all data sent between the CRT terminal and the computer, when the terminal is set to HALF-DUPLEX.

In this manner the peripherals are used for "on-line" logging of the computer-terminal dialog.

(2) The peripherals receive data sent from the computer to the terminal when the terminal is set to FULL-DUPLEX.

This reception mode is essentially on-line logging of data sent to the CRT for display.

The PRINT ON-LINE state also permits any data sent from the cassette to the CRT to be transmitted as well to the computer and the printer.

(b) PRINT LOCAL

This is a momentary contact key which can be effective only when the terminal is not in the PRINT ON-LINE condition.

The PRINT LOCAL key initiates a block transfer of the contents of the CRT display page to the cassette and printer. No data is transmitted to the processor interface. Thus, PRINT LOCAL effects a "local dump" of the CRT to the peripheral interface.

4.3.3.3 Interface Timing Control

Two switches at the rear of the terminal control interface timing:

(a) PRINTER (ON-OFF)

This switch should be in the OFF position when the printer is not plugged in, or when the printer is plugged in but its power supply is turned off.

(This switch grounds the Printer Busy line - see Table 4.3)

(b) CASSETTE (ON-OFF)

This switch should be OFF when the cassette (or other serial device) is not plugged in. When the switch is OFF, peripheral output timing is controlled by the printer, i.e. -

In LOCAL PRINT output rate is controlled by Printer "hadnshaking", with a forced time-out for characters output by the terminal which are not recognized by the Printer. The time-out is necessary because characters such as SO, SI and GS which are not recognized by the Printer do not cause Printer Busy to occur.

In PRINT ON-LINE the transfer rate is controlled by the Printer for a terminal equipped with a parallel computer interface and by the Baud Rate switch for a terminal equipped with serial computer interface.

When the cassette switch in ON, LOCAL PRINT occurs at a maximum speed determined by the Baud Rate Switch and a minimum speed equal to the slower of the Baud Rate Switch, or the Printer.

Table 4.3

PRINTER/CASSETTE INTERFACE

PIN ASSIGNMENTS

A. Printer (Parallel Output) Connecter

Pin	Signal	Pin	Signal
1	NC	14	Printer Start
2	"	15	Printer Start Gnd
3	"	16	Printer Busy
4	"	17	Printer Busy Gnd
5	Chassis Gnd	18	B1HC Data Bit 1
6	"	19	B2HC Data Bit 2
7	"	20	NC
8	"	21	B3HC Data Bit 3
9	"	22	B4HC Data Bit 4
10	"	23	B5HC Data Bit 5
11	"	24	B6HC Data Bit 6
12	"	25	B7HC Data Bit 7
13	"		

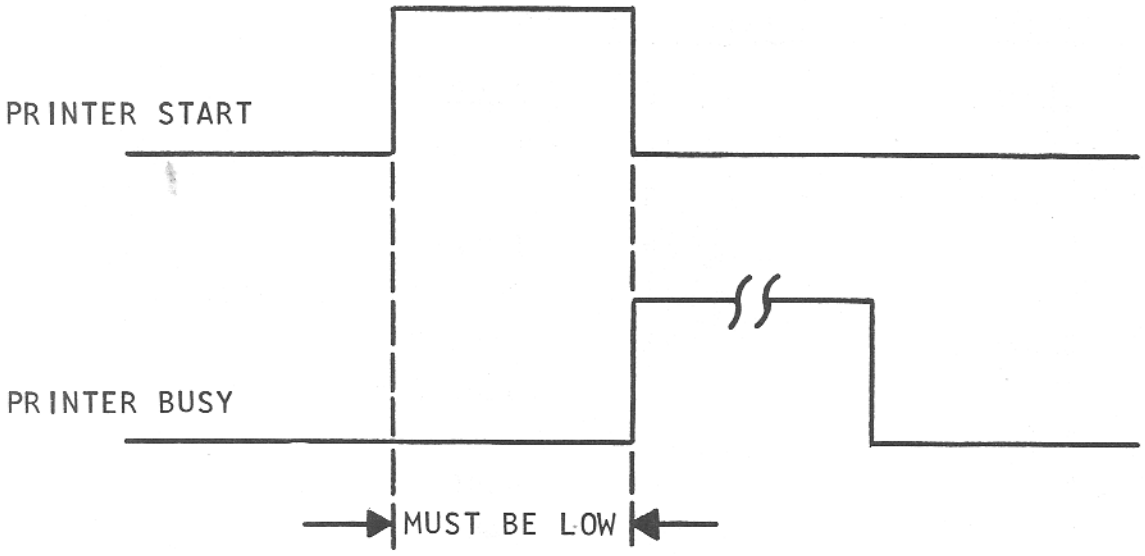
B. Cassette (Serial Input/Output) Connector

Pin	Signal
1	Protective Gnd*
2	Transmitted Data (from peripheral to terminal)
3	Received Data (from terminal)
4	Request to Send
5	Clear to Send
6	Data Set Ready
7	Signal Gnd*
8	Received Line Signal Detector
11	TTY Input 1 } Contact closure inputs from TTY
18	TTY Input 2 }
20	Data Terminal Ready
21	TTY Output (-) Gnd
25	TTY Output (+) 20 MA out

*(Pins 1 and 7 must be jumpered together by the user.)

PRINTER TIMING

Fig. 4-3



1. THE TERMINAL GENERATES THE PRINTER START SIGNAL, WHICH IS APPROXIMATELY 10 MICROSECONDS WIDE.

2. AFTER THE PRINTER START SIGNAL DROPS, THE PRINTER CAN RAISE PRINTER BUSY. THE PRINTER BUSY SIGNAL SHOULD BE HIGH FOR A MINIMUM OF 10 MICROSECONDS. ON THE FALLING EDGE OF PRINTER BUSY, THE TERMINAL MAY OUTPUT ANOTHER CHARACTER. (MAXIMUM OUTPUT RATE OF TERMINAL IS ONE CHARACTER EVERY 635 MICROSECONDS.)

3. (WHEN IN LOCAL PRINT) IF NO PRINTER BUSY IS RECEIVED WITHIN 10 MICROSECONDS AFTER THE TRAILING EDGE OF THE PRINTER START, THE TERMINAL WILL FETCH THE NEXT CHARACTER AND GENERATE ANOTHER PRINTER START.

4.3.4 Keyboard Interface (MRD-700 Series only)

The MRD-700 Series provides terminal electronics in a rack-mountable package, with provision for connecting a keyboard and monitor supplied by ADDS or a special keyboard (and monitor) supplied by the user. If a keyboard is ordered from ADDS it normally comes in a separate metal enclosure and a six-foot length of cable terminated by two 25-pin male connectors. These connectors plug into two 25-pin female connectors (labeled "KEYBOARD A" and "KEYBOARD B") located on the rear panel of the MRD-700.

If an ADDS keyboard is plugged in, the user does not have to get involved with interface details. However, if he wishes to connect his own equipment to the keyboard interface the pin assignments of Table 4.4 and the timing shown in Figure 4.4 should be observed. Note the following:

(a) Pins A8 through A2 represent the ASCII bits B7 - B1, in inverted form. The asterisk in Table 4.4 indicates inverted logic.

When an encoded key on the ADDS keyboard is depressed the data bits become stable, and then the "Keyboard Strobe" signal goes from +5 volts to Ground and stays at Ground until the key is released.

(b) All function lines (A10 through A12, and B1 through B10) are normally low (ground) and go high (+5 volts) when the key is depressed. The Local Print and Transmit functions are initiated when the corresponding keys are released. (High-to-low transition) All other functions are initiated when the key is first depressed (low-to-high transition).

(c) When the "Print On-Line" function line (B8) is at +5 volts all data transferred via the processor interface is also output on the printer/cassette interface. When this line is at Ground the PRINT ON-LINE state is disabled.

(d) When the REPEAT key is held down the corresponding function line (B10) is at +5 volts and will cause any action corresponding to another key which is simultaneously depressed to be repeated at a rate of 15 times per second.

NOTE

In the event the MRD-700 is ordered without a keyboard (or is operated without the keyboard plugged in) the keyboard connectors must be jumpered as shown in Table 4.5 for the terminal to operate.

Table 4.4 MRD-700 Series

KEYBOARD INTERFACE CONNECTIONS

Keyboard Connector A

Pin	Signal	Pin	Signal
1	Power +5 v	14	Chassis Gnd
2	B1KB* (Data Bit 1)	15	"
3	B2KB*	16	"
4	B3KB*	17	"
5	B4KB*	18	"
6	B5KB*	19	"
7	B6KB*	20	"
8	B7KB*	21	"
9	Keyboard Strobe	22	Keyboard Strobe Gnd
10	Local Print	23	Local Print Gnd
11	Transmit	24	Transmit Gnd
12	Delete	25	Delete Gnd
13	NC		

Keyboard Connector B

Pin	Signal	Pin	Signal
1	Cursor Up	14	Cursor Up Gnd
2	Cursor Down	15	Cursor Down Gnd
3	Cursor Forward	16	Cursor Forward Gnd
4	Cursor Back	17	Cursor Back Gnd
5	Cursor Home	18	Cursor Home Gnd
6	Break	19	Break Gnd
7	Insert	20	Chassis Gnd
8	Print On-Line	21	"
9	Control	22	"
10	Repeat	23	"
11	NC	24	"
12	NC	25	"
13	NC		

Table 4.5

JUMPERS REQUIRED FOR MRD-700

OPERATED WITHOUT KEYBOARD

Jumpered to 5 volts

Pin A-9

Jumpered to ground

Pin A-10
A-11
A-12
B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-9
B-10

To Control Print On-Line State

(if Hard Copy interface provided)

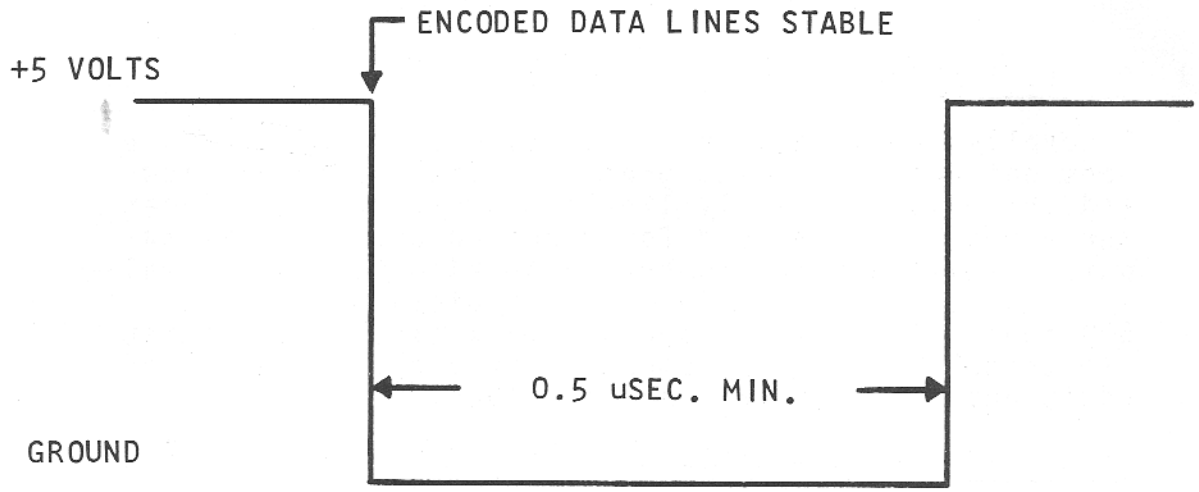
Pin B-8: +5 volts to enable PRINT ON-LINE state

or

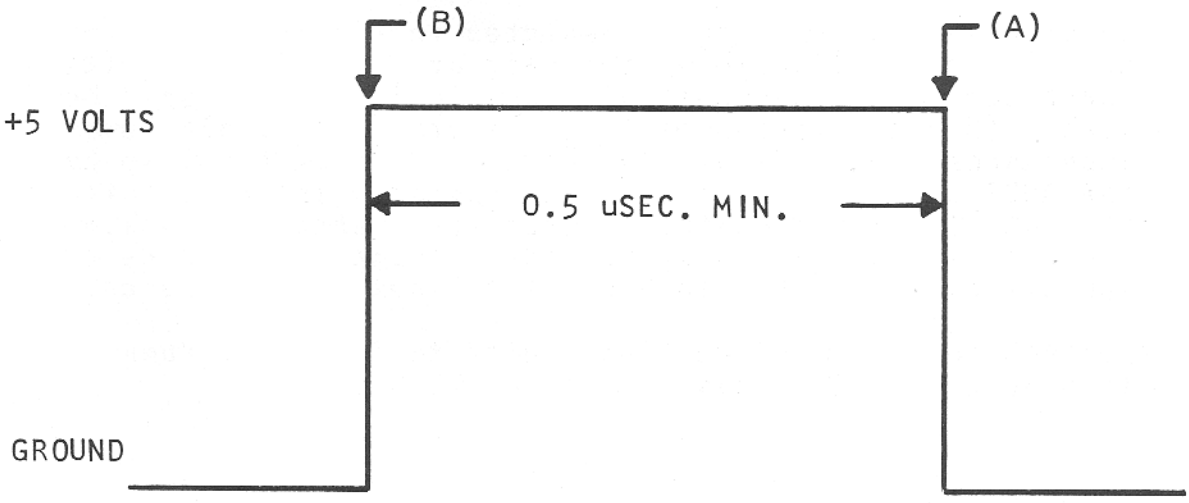
Ground to disable PRINT ON-LINE state

KEYBOARD INPUT STROBE - TIMING

Fig. 4-4



KEYBOARD FUNCTION LINES - TIMING



(A) LOCAL PRINT AND TRANSMIT INITIATED

(B) ALL OTHER FUNCTIONS INITIATED

4.4 Interface Cabling Design

Two types of interfaces were described previously:

- Serial (EIA/TTY), and
- Parallel

4.4.1 Serial Cabling

Generally speaking, the serial type of data interface does not pose a cabling problem. Data rates are low and there is relatively little cross-coupling between the wires that are used for received and transmitted data. Twisted pair (number 22 or 24 wire) can normally be used for EIA serial data at distances of 300-500 feet. Greater distances (or particularly intense electrical noise environments) may dictate the use of additional line drivers and receivers.

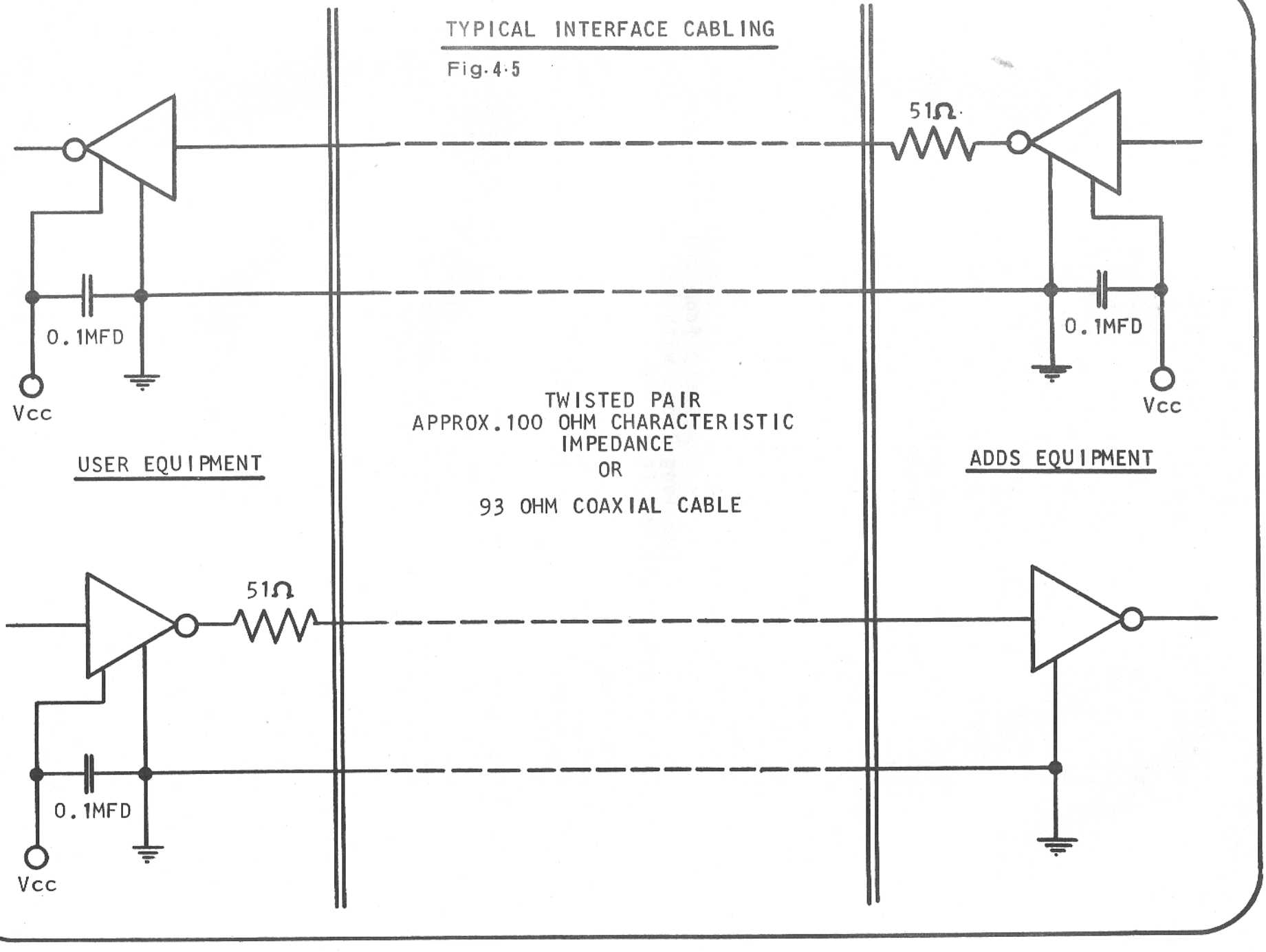
4.4.2 Parallel Interface Cabling

Good cabling practice is essential for parallel interfaces. Crosstalk and line reflections in the cable are easily handled with TTL logic if the high frequency characteristics and low impedances of TTL are considered.*

The ADDS logic is TTL, and we shall assume in this section that the user will also employ TTL logic. The outstanding characteristic of TTL logic which reduces cross-coupling is its extremely low output impedance in the "0" and "1" states. If other types of logic are employed the user should design his drivers for low output impedance. It may be necessary for the user to connect drivers in parallel; this is not generally required with TTL logic.

Interconnection cabling is depicted in Figure 4.5. For each interface signal twisted pair or coaxial cable with characteristic impedances of close to 100 ohms should be used. (Higher impedances increase crosstalk while lower impedances are difficult to drive.) Signals supplied by the ADDS equipment have a 51 ohm resistor in series with the output, providing that source resistance to the line. The user should similarly provide a source resistance of approximately 50 ohms in his drive lines out to the cable.

*For a thorough technical discussion, refer to Texas Instruments Application Note CA-108, "Noise in 54/74 TTL Systems."


TYPICAL INTERFACE CABLING
Fig.4-5
51Ω
0.1MFD
Vcc
TWISTED PAIR
APPROX.100 OHM CHARACTERISTIC
IMPEDANCE
OR
93 OHM COAXIAL CABLE
USER EQUIPMENT
ADDS EQUIPMENT
51Ω
0.1MFD
Vcc

(Note that a simple bare collector out to the line is incorrect; the series resistor should be used to provide correct source impedance.)

Note also that line-driving and line-receiving gates should be decoupled as close to the package V_{CC} and ground pins as practical. Drive lines out from the ADDS equipment are individually decoupled with .01 MFD. Moreover, the printed circuit cards in ADDS equipment use a ground plane and cards are decoupled with approximately 10 MFD. The user should similarly decouple his logic; capacitance of .1 MFD per driver is recommended.

The reader may observe that the cabling scheme described above implies a deliberate mis-match; i.e., driving a 100-ohm line with source impedances of 50 ohms. It is true that source impedances of 100 ohms result in very "clean" signals with no appreciable steps in the pulses due to line mis-match. However, driving from source impedances of 100 ohms causes a loss of 160 millivolts of noise immunity at the receiving end, out of a total worst-case immunity of approximately 400 millivolts. When source impedances of 50 ohms are used, the loss is cut from 160 to 80 millivolts. Another equally important reason for reducing source impedance from 100 to 50 ohms is the ability to drive long lines with half as much degradation of pulse rise and fall times.

Reduction of source impedance to less than 50 ohms is not recommended since, in that case, the steps in pulse leading edges and overshoot on trailing edges become unacceptable.

The importance of good cabling design is clearly seen from considering the following table of cable type versus distance. (These figures must be considered only approximate. For example, if high electrical noise levels are encountered coaxial cable could be mandatory at any distance.)

Cable Type	Cabling Distance (Approximate)
Direct wire interconnection, with no specific ground return. Ground plane always desirable.	10 inches
Direct wire interconnection, with ground return. Routed close to ground plane.	20 inches
Twisted pair, #26 or #28 wire with thin insulation twisted about 30 turns per foot.	35 - 50 feet
Coaxial cable with 93 ohm characteristic impedance (RG 62)	200 - 250 feet

Since coaxial cable is expensive and bulky, twisted pair is used in most applications and works quite well if the recommended practice is followed.

To summarize design rules:

(a) Use twisted pair or coaxial cable with a characteristic impedance of approximately 100 ohms.

(b) Drivers shall have a source impedance of approximately 50 ohms.

(c) Carry transmission line ground returns through at both the transmitting and receiving ends. (Within ADDS equipment critical request-response lines and their ground returns are actually carried on twisted pair from the I/O connector to the logic backplane.)

(d) Decouple line-driving and line-receiving gates.

(e) Gates used as line drivers should be used for that purpose only. Gate inputs connected directly to a line driving output could receive erroneous inputs due to line reflections, long delay times introduced or excessive loading on the driving gate.

(f) Gates used as line receivers should have all inputs tied together to the line. Other logic inputs to the receiving gate should be avoided and a single gate should be used as the termination of a line.

(g) Flip-flops are generally unsatisfactory line drivers due to the possibility of collector commutation from reflected signals.

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